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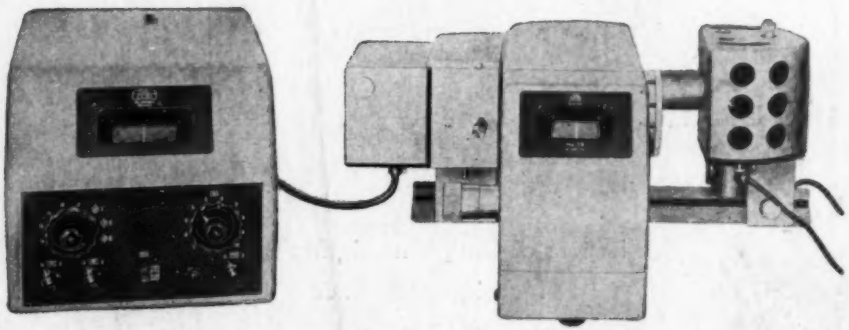

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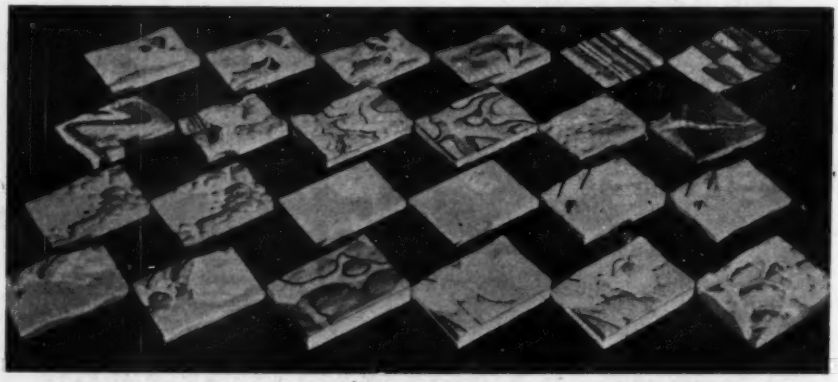

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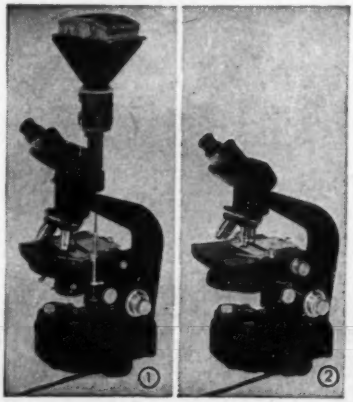

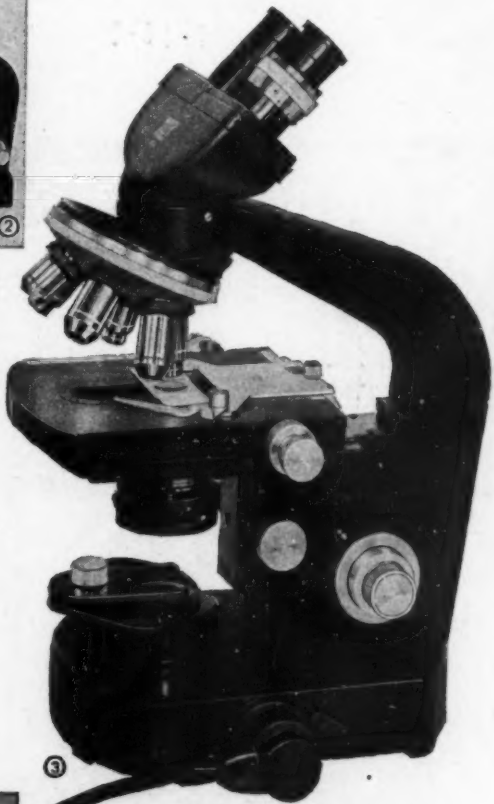

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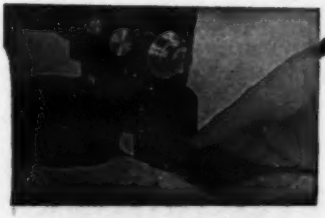

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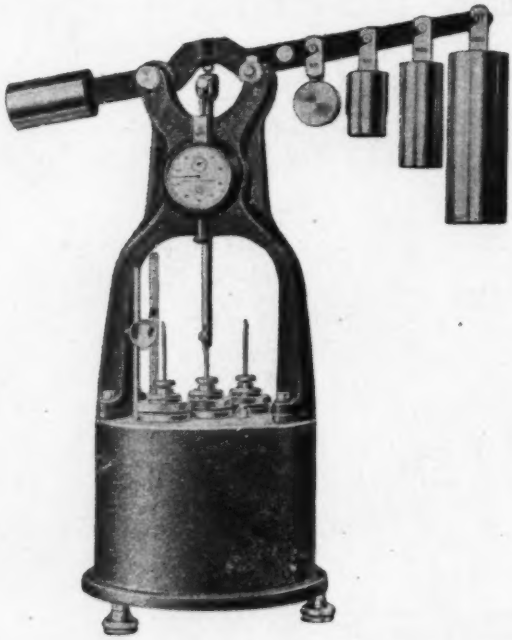

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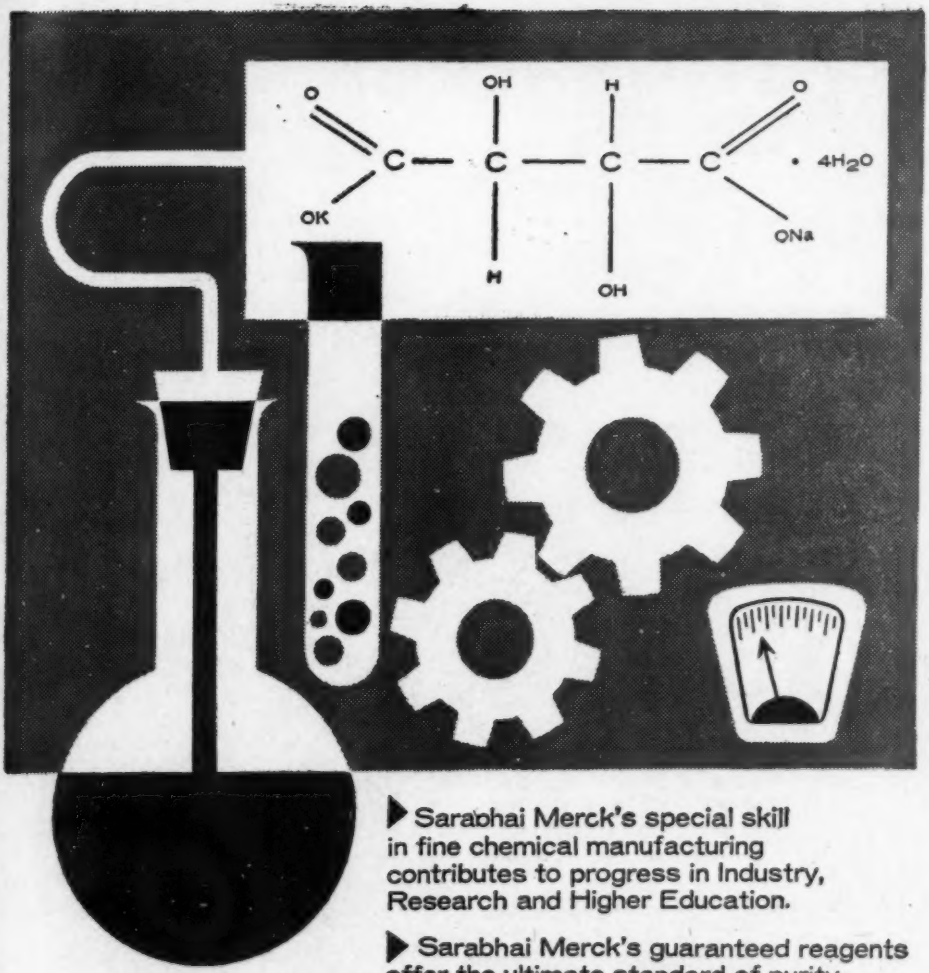

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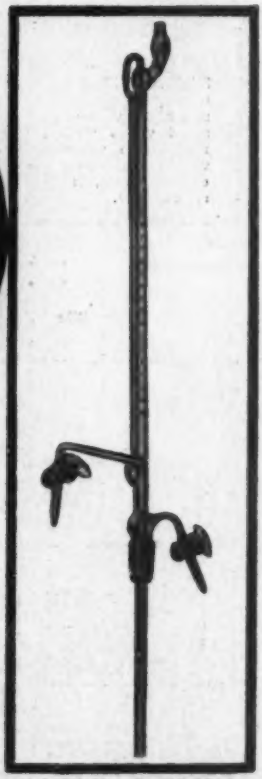

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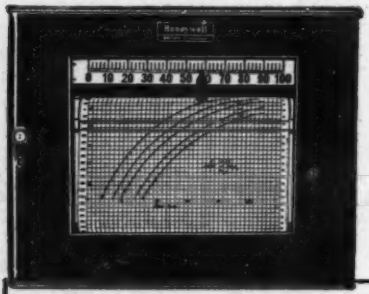

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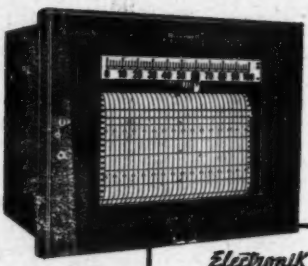

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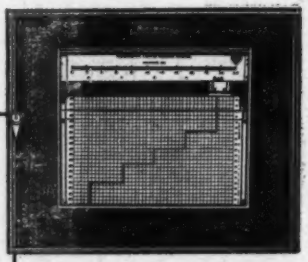

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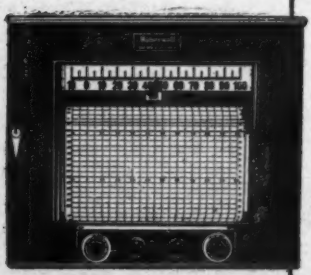

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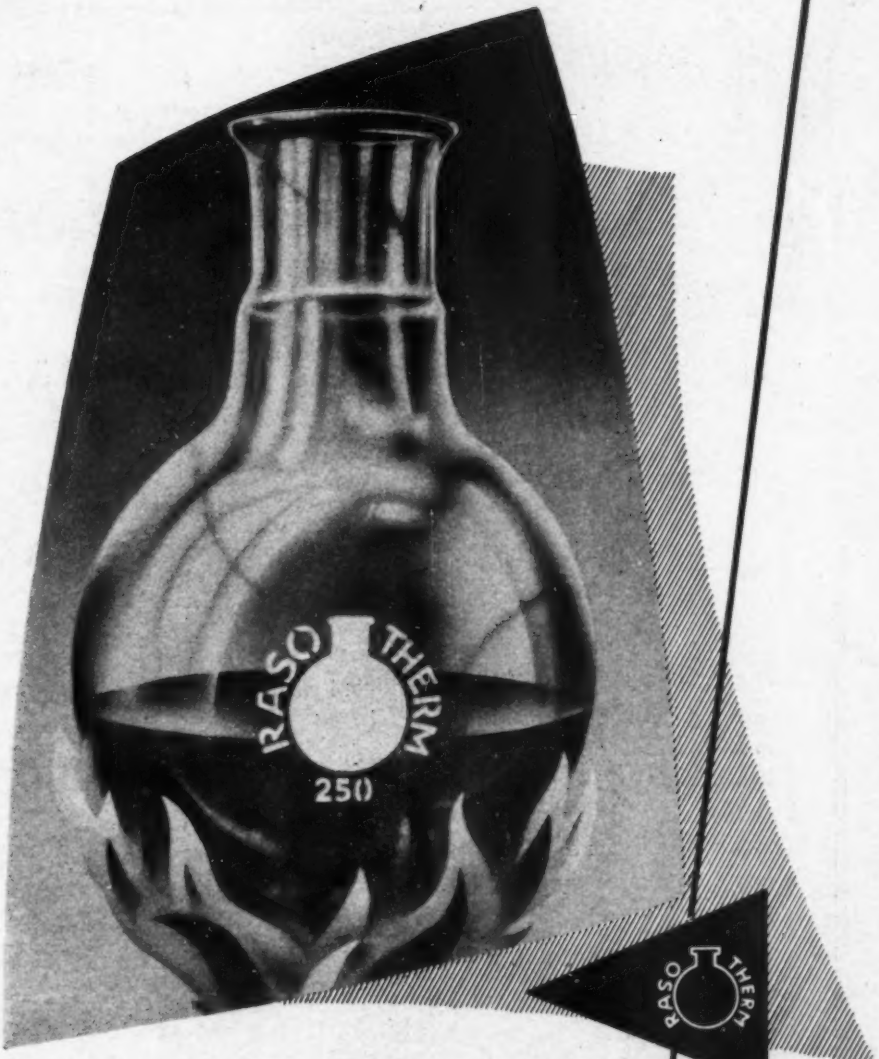

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DOUBLE STAR ASTRONOMY*

DOUBLE star astronomy has always played a major part in the development of astrophysics. Its importance lies in the data it provides in formulating a consistent theory of stellar evolution. The ultimate problem of the study of binary stars is to gain an understanding of the cosmic processes which led to their formation, or which may control their astronomical future. As early as 1902, A. W. Roberts in the pioneer days of double star astronomy wrote : "the study of Algol variables should bring us to the very threshold of the question of stellar evolution, and to the heart of not a few of the greatest cosmical problems". The evolution of stars constitutes a process so slow when measured in terms of human time-scales that no changes arising from it can become perceptible within the brief period of a few centuries over which the subject has been studied. Hence the only method of testing theories of stellar evolution that have been propounded from time to time is to compare the theoretical deductions with the observed *statistical* properties of different types of stellar populations. The success of such tests will naturally depend on the range of information that can be gathered from observations of the various stellar types. In this context double star astronomy plays a unique role in that there is no other branch of practical astronomy which can supply such a wealth of data as can be obtained from detailed studies of close binary systems, especially of the eclipsing type. Close binaries are not a rare phenomenon either. At least seven eclipsing variables are known within 30 parsecs from the Sun, and as this volume contains some 3,000 stars, eclipsing binaries constitute about 0·2%, and the total number of binaries for all values of celestial inclinations may be in the neighbourhood of 1%, that is, in our galactic system as a whole the number of close binaries may be estimated as of the order of 10^9.

As a result of systematic work on the orbital and other characteristics of close binary systems in the galaxy many unexpected and exciting results have emerged. One such is Kuiper's deduction that the solar system is a degenerate double star in which the second mass did not condense into a single star but was spread out, and formed planets and comets. Another recent advance is the finding of Struve that close binaries interact not only dynamically but also *physically* and that there is frequently an interchange of matter from one star to its companion. These results together with the fact which recent studies have fairly well established, namely, that many of the very close binaries are evolving, so to say, right before our eyes, have made the study of close binary systems a subject of paramount importance in contemporary stellar astronomy. Visual binaries are sometimes separated by hundreds—often thousands—of astronomical units (AU, distance of Sun from the earth), so that several generations of astronomers are needed to observe even a small part of their orbital motion, but close binaries may make thousands of revolutions in a comparatively short time. For example, the binary star UX *Ursæ Majoris* completes one revolution in 4 hours 43 minutes, the shortest known period among binaries. The great significance of many short-period systems is that they give evidence of physical change taking place during the microscopically short lifetime of an astronomer, and there is some chance of his studying at least a small portion of the life-history of this type of stars. Such stars may truly be said as the astronomers' *drosophilæ*.

The term binary star was first used by Sir William Herschel in 1802, to designate a *real double star* which is "the union of two stars that are formed together in one system by the laws of attraction". It is to be distinguished from what is popularly referred to as "double star" to describe a close pair of stars which are really different in distance and age, having no physical connection, and owe the proximity of their projections on the celestial sphere only to the laws of chance. Double star systems vary widely both as regards their period, and the separation of the components. Their periods range from a few hours to about 10^7 years. As regards separation, there are pairs in which the components are almost in contact (contact binaries), and those in which the separation is of the order of 44,000 AU.

Binary systems are of two types : (*i*) wide (or visual) binaries which are resolvable through a telescope, and (*ii*) close binaries, which although they are not resolvable by telescopes, may yet be identified as binaries either (*a*) by the periodic variation of intensity (eclipsing binaries), or (*b*) by observing spectroscopically the Doppler shift due to varia-

* *Close Binary Systems*. By Zdenek Kopal. International Astrophysical Series, Vol. V. (Published by Chapman and Hall, Ltd.). 1959. Pp. xvi + 558. Price 105 *sh*.

tion in their radial velocity (spectroscopic binaries). Both eclipsing and spectroscopic binaries belong to the same physical group and differ in their observable manifestations only by an accident of orientation of their orbits in space.

Wide binaries are of limited interest from the point of view of getting information; for apart from their mutual attraction which makes them to revolve in closed orbits around their common centre of gravity, the components do not influence each other in any other way, but behave, and probably also evolve, like single stars in space. The distance between wide binaries are very large compared to their stellar diameters. With increasing proximity, however, there will be mutual dynamical interaction between the two, and distortions and perturbations of significance will arise from tidal actions and axial rotations. The shape of the individual components will depart from a sphere, and provided that the free oscillations of the components are sufficiently short in comparison with the period of the orbit, the appropriate distortion of both will be governed by the equilibrium theory of tides, *i.e.*, the component stars will be distorted ellipsoids.

In interpreting the observed changes in the brightness of close binary systems, the effects of the distortion will have to be taken into account. Since the components of the eclipsing binaries are distorted ellipsoids with their longest axes constantly in the direction of the radius-vector, their apparent area—and, therefore, the light—as seen from the earth should vary continuously in the course of a revolution (*ellipticity effect*). It will also happen that part of the radiation of each component will fall on the other where it will be absorbed and re-emitted in all directions. This produces the *reflection effect*. There effects in the intensity of the light from close binaries will be in addition to, and independent of the light changes which arise from eclipses. The theoretical distribution of brightness over their apparent discs as seen by a distant observer can be deduced from the laws of limb-darkening and gravity-darkening as shown by Chandrasekhar. It may be noted that the limb-darkening tends to make brightest those parts of the visible surface which are nearest to the observer, the gravity-darkening those which are nearest to the star centre. The theory of the determination of the orbital elements of close binary systems from the properties of the photometric light curves, developed by Russell and Shapely, has enabled astronomers to estimate the sizes and shapes of component stars, as well as their luminosities and separations. Because many factors influence the shape of the light curve, complete analysis is often difficult.

It is in this particular field of investigation that Prof. Kopal, the author of the book under review, has made many significant contributions, and so the book is authoritative on the subject. It gives first-hand knowledge of the methods by which photometric and spectroscopic observations of close binary systems can be analysed to yield all possible information about their components. After the first introductory chapter, Chapter II deals with the general dynamics of close binary systems. Chapter III discusses the geometrical analysis of the Roche model or the centrally condensed model in which the components of the system are represented, for gravitational purposes, by two mass points. The importance of this model and the significance of what is shown as the Roche limit, in the author's theory of the evolution of binary systems, have been brought out clearly in a later chapter. Chapters IV and V contain a systematic development of the theoretical light-, and radial velocity-curves exhibited by distorted rotating components of close binary systems, between minima, as well as within eclipses. Chandrasekhar's elegant proof of von Zeipel's theorem relating to radiation flux in distorted stars is included here.

The most important chapter in the whole book is Chapter VI which covers nearly a third of the book. It deals with the determination of the elements of eclipsing binary systems from an analysis of their observed light changes. As mentioned already, the author himself is noted for his many contributions in this branch of the subject and, in fact, the contents of this chapter are largely a consolidated account of these contributions in what is known as Kopal's iterative methods, as opposed to the well-known direct method developed by Russell and Shapely. The concluding Chapter VII is on physical properties of close binary systems, and in the last section of this chapter the author, taking stock of all the known facts of binary systems, explains what they reveal concerning the origin and evolution of binary stars.

The origin of close binary systems is no doubt to be sought in the same general processes which lead to the formation of stars. The accepted theory is that the stars originate by a gravitational collapse of cosmic gas-clouds containing enough mass to give birth to hundreds or thousands of individual stars at the same time. Close binaries were formed

simultaneously with single stars as by-products of essentially the same formative process. It is also evident that the chemical composition of the two components in each pair was initially the same at the time of formation. Their masses, however, were different and this has made all the difference in their subsequent evolution. The story of this evolution containing new ideas is told in the last chapter of the book.

This volume amply fulfils the main purpose of the International Astrophysical Series, which is to provide an authoritative account of the subjects in a manner to assist their teaching and advancement.

UNITED STATES' SUCCESS IN MANNED SPACE FLIGHT

A NOTABLE success in space flight was achieved by United States when on May 5, 1961, it sent a man into space and recovered him safely. The astronaut was 37-year old Commander Alan Shepard of the United States Navy. The space capsule in which Shepard rode was 6 ft. × 9 ft., a little bigger than a telephone booth, and weighed about one ton. It was blasted into the sky in the 66 ft. Redstone rocket from the missile base at Cape Canaveral, Florida, at 9·34 a.m. (14·34 GMT) on Friday, May 5, 1961. The capsule soared in a vast ballistic arc over the Atlantic and plummetted into the sea inside a ring of recovery ships just fifteen minutes later. Shepard climbed out of the capsule unaided and was winched to safety by a marine helicopter which landed both astronaut and capsule on the deck of the recovery ship, the aircraft carrier Lake Champlain stationed 290 miles downrange from the site of launching. The historic flight was the climax of two and a half years' work and 400 million dollars expenditure. It closely followed Russia's success in the first manned space flight just 23 days previously when on April 12, Major Gagarin orbited the earth once round in his 108-minutes flight in the space ship Vostok (*see Curr. Sci.*, April 1961).

The essential details of the US space flight have been reported as follows : The weather this morning was fine and Shepard was driven out to the launching pad in a van. His aluminised space suit gleamed in the glare of the arc lights as he squeezed through the tiny hatch of the capsule and wriggled on to the specially contoured couch. Shepard was sealed in the capsule at 6-10 a.m. (11·10 GMT). At blast-off, flame leaped from the base of the rocket and it began to lift into the air with a shattering roar, ponderously at first, then with gathering speed. Shepard was forced deep into his form-fitting couch by the fierce gravitational pull as the rocket vanished into the clouds and accelerated to a speed of over 4,000 miles per hour in a few seconds. Shepard's voice crackled into the tense control room. His first words were—"what a beautiful view". From then on, he reported continuously to the control room on how he felt and the behaviour of the rocket. He spent much of the flight with his eyes shut, reading the instruments by touch, as he fought the massive strain of 11 G.—eleven times the force of gravity. Subsequently Shepard reported : "I am now experiencing six G's-, five G's-, four G's-.

The capsule separated from the rocket when it was 90 miles up, and Shepard took over manual control of the capsule and performed basic manœuvres in different directions. He performed a roll successfully. He reported he had fired the retro-rockets to slow down the capsule before it plunged into the Atlantic. After being weightless for several minutes, Shepard prepared for the critical re-entry into the earth's atmosphere. He talked to recovery ships. Moments later slowed by the retro-rockets, the capsule decelerated further as Shepard opened his secondary parachute. Then the great red and white main parachute opened and watchers on the recovery ships saw the capsule for the first time as it drifted down to the Atlantic. A landing bag beneath the capsule inflated to cushion the fall when the capsule hit the sea 80 miles north-west of Grand Bahama island and three miles from the aircraft carrier Lake Champlain. Shepard climbed out of the capsule as a marine helicopter swooped down on him. Three minutes later he was aboard the helicopter, which also winched up the capsule.

An official announcement by the National Aeronautics and Space Administration (NASA) said : "The Project Mercury spacecraft carrying astronaut Alan Shepard on the nation's first manned flight landed on the Atlantic Ocean about 302 statute miles from here at 9-49 a.m. E.S.T. The altitude was about 115 miles, the speed about 5,100 miles per hour. The sub-orbital flight required 15 minutes. Preliminary data show the pilot performed satisfactorily during flight." The blast-off time was officially announced as 9 hours 34 minutes and 13 seconds a.m.

SEISMIC EXPLORATION IN THE KARAIKAL-NAGORE AREA OF THE CAUVERY BASIN, MADRAS STATE*

L. N. KAILASAM
Geological Survey of India

GRAVITY and magnetic surveys of the coastal sedimentary belt of Madras State were started by the Geological Survey of India in 1954 with a view to investigate the thickness of the marine sediments and their stratigraphic and structural disposition for assessing the possibilities for petroleum in the area and to locate additional hidden lignite deposits, if any. An account of the investigations carried out in the coastal areas of South Arcot District by the author was published in *Current Science*, 1958, 27, 476. Subsequently, an east-west reflection seismic traverse, extending from the crystalline outcrops to the west of Vriddhachalam town to Porto Novo on the sea coast across the sedimentary belt, was conducted along the Vriddhachalam-Bhuvanagiri-Porto Novo highway. The seismic data have indicated a thickness of the order of 9,000 feet over the seacoast near Porto Novo, which is quite encouraging from the point of view of petroleum occurrence, adding significance to the gravity 'highs' outlined earlier immediately to the south of Porto Novo as also to the north.

The gravity and magnetic surveys have since been extended southwards across the Coleroon and Cauvery Rivers, and a major part of the Cauvery basin covering an area of roughly 4,000 square miles in the Tanjore District has been surveyed by gravity and magnetic measurements by Y. R. Bhanumurthy and party under the direction of the author.

The geological features of this coastal sedimentary belt have been described by a number of geologists in published papers. A brief summary of the same has also been furnished in the author's earlier paper referred to above. The widest portion of the coastal sedimentary basin lies in the Tanjore District including the off-shore part in the Palk Straits. Most parts of the Cauvery basin in the Tanjore District are covered by Cuddalore sandstones of Miocene age. These consist of grits, pebble beds, argillaceous sandstones, clays and sands. Some poorly developed exposures of the marine Cretaceous can be seen a few miles to the west of Tanjore town. The presence of salt and gypsum in the earliest strata of the Cretaceous afford evidence of desiccation in an enclosed basin.

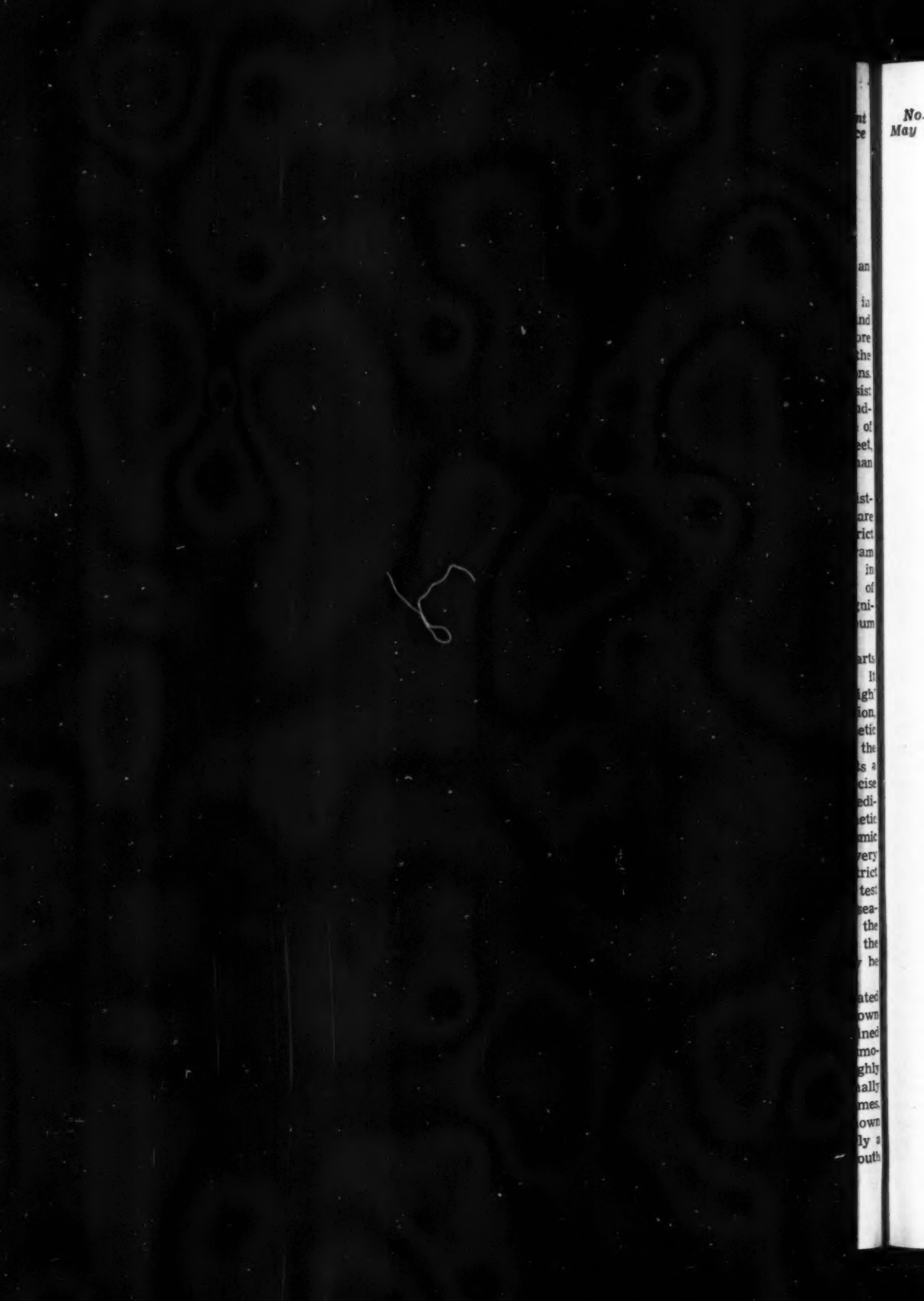
Eocene sediments have been encountered in a number of deep bore-holes sunk for ground water both in the South Arcot and Tanjore parts of the sedimentary belt, underlying the transgressive Miocene (Cuddalore) formation. The Eocene rocks have been reported to consist of clays, soft shales and limestones with abundant micro-fossil content. The bore-holes, some of which have been taken to depths of 1,500 feet, have so far indicated a thickness of more than 800 feet for the Eocene strata.

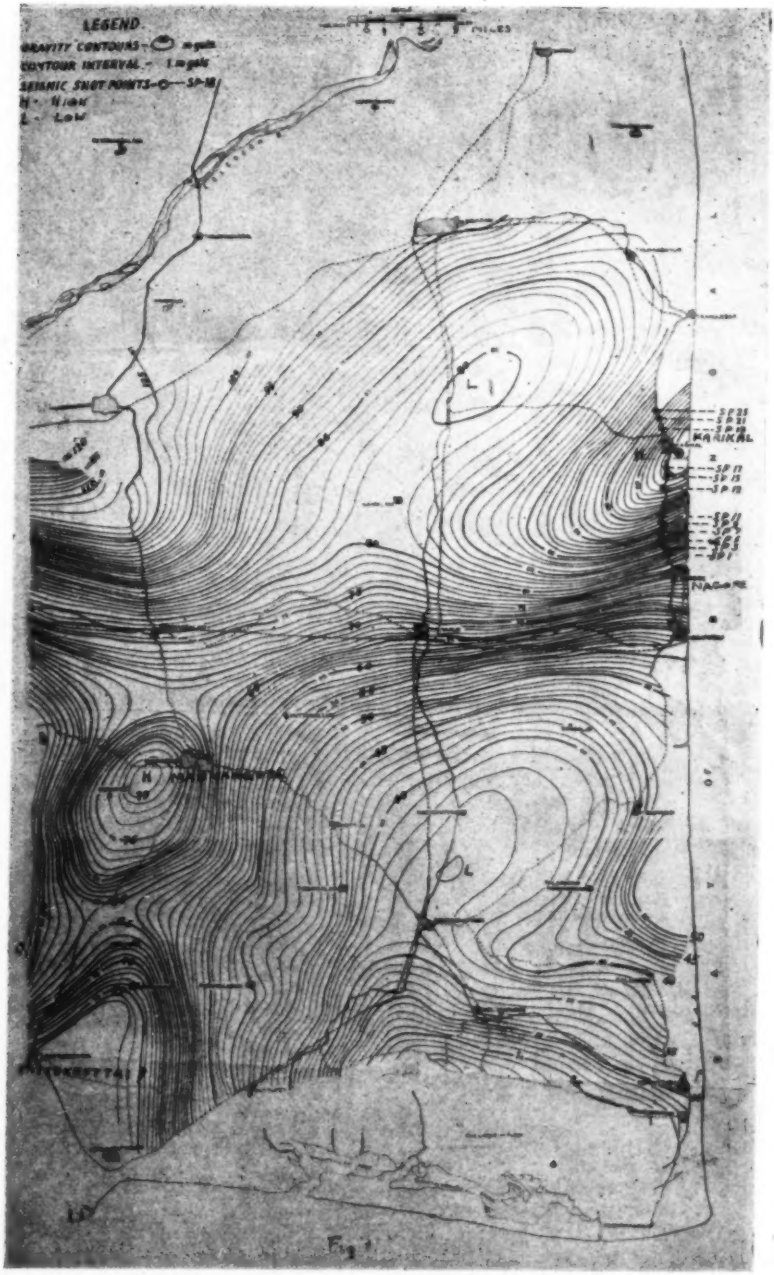
Exposures of Upper Gondwana rocks consisting of sandstones, grits and micaceous shales are seen near Uttattur in the Trichinopoly District and near Sivaganga in the Ramanathapuram District, but these exposures do not occur in the Tanjore District. These rocks, being of terrestrial and fluviatile origin, have no significance from the point of view of petroleum occurrence.

The Bouguer gravity map of the eastern part of the Cauvery basin is shown in Fig. 1. It may be noted that a prominent gravity 'high' is indicated in the Karaikal-Nagore region which has also been corroborated by a magnetic 'high'. This feature extends partly into the sea, but the nature of the indication suggests a definite closure. In order to obtain precise information regarding the thickness of the sediments for interpreting the gravity and magnetic data, it was decided to run a test seismic traverse in the Tanjore District of the Cauvery basin as was done in the South Arcot District to the north of the Coleroon River. The test traverse was conveniently taken over the seacoast in a north-south direction along the Nagore-Karaikal-Tranquebar road across the gravity feature. This structural feature may be designated as the 'Karaikal Structure'.

The various seismic shot points are indicated in Fig. 1 and the seismic time-section is shown in Fig. 2. A number of clear and well defined reflections have been brought out in the seismograms (Fig. 3) with two-way times of roughly 0·55, 0·75, 1·08, 1·55, 1·68, 1·85 and occasionally more than 2·0 seconds. The two-way times, plotted after the necessary reductions, are shown in Fig. 2. The time-section indicates clearly a marked reversal of dip in the north-south

* Published with the kind permission of the Director, Geological Survey of India.




LEGEND
GRAVITY CONTOURS
CONTOUR INTERVAL
SEISMIC SHOT POINTS
H - High
L - Low
KARAIKAL
NAGORE

direction, confirming the gravity indication. The reversal of dip is indicated practically in all the reflecting horizons. The marked reversal of dip in the north-south direction is also clearly discernible in the seismograms for shot points 2 and 20 reproduced in Fig. 3.

The Karaikal structure appears to be significant and important both in respect of its size and nature regarding its petroleum possibilities, and a test drill-hole may advantageously be put down at a point very near Karaikal town (Fig. 1), after outlining the structure fully with

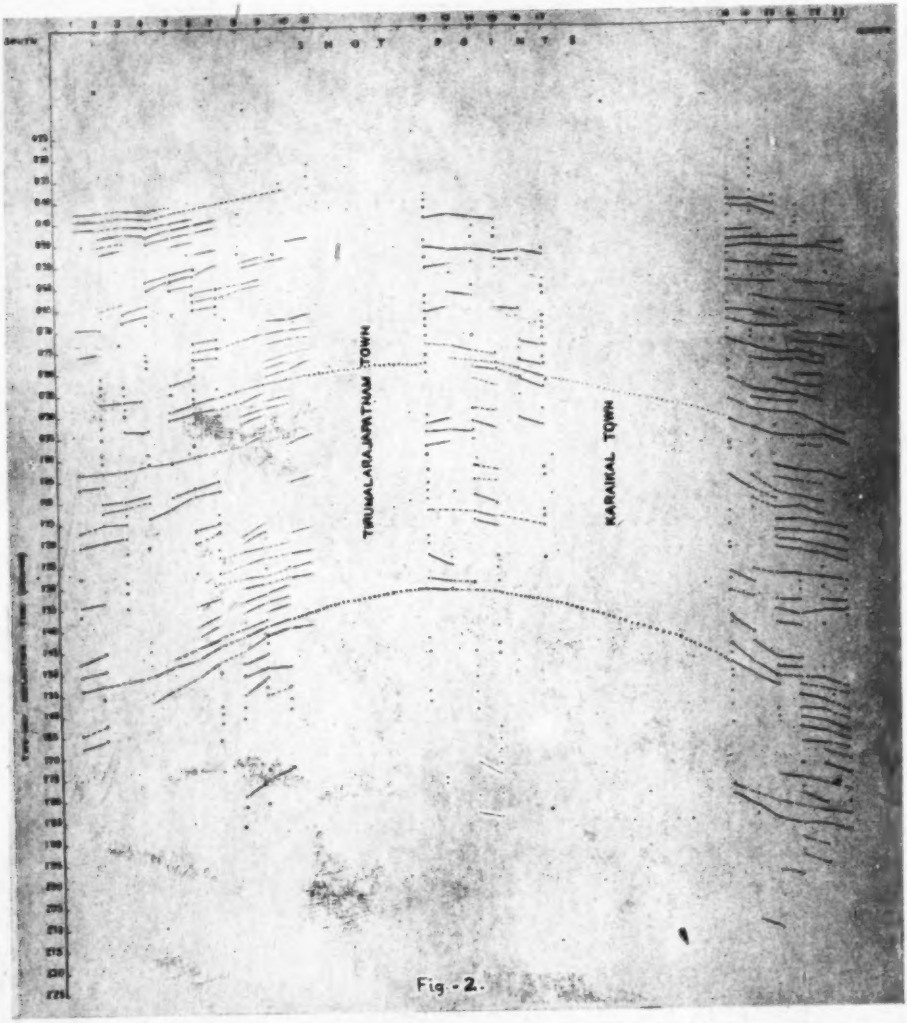


Fig. 2.

The seismic data also indicate a thickness of the order of 9,000-10,000 feet for the sediments in the coastal areas near Karaikal, which is more or less of the same order of thickness indicated in the Porto Novo area in the South Arcot District.

the aid of additional seismic profiles with some off-shore observations over the portion of the feature extending into the sea. This incidentally indicates the scope for off-shore exploration for oil near the Madras coast.

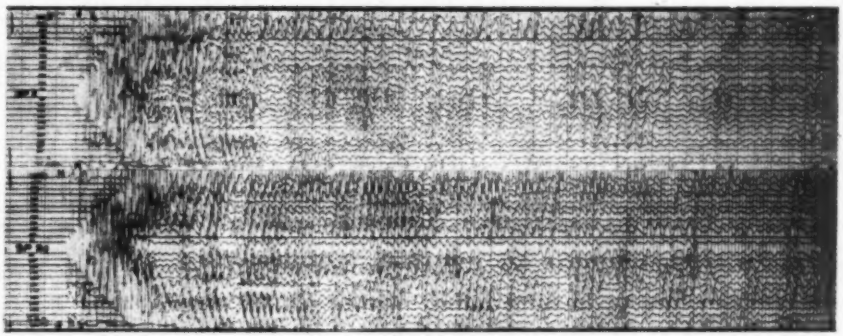


FIG. 3

The other prominent anomaly in the Mannargudi-Pattukkottai area trending in a north-south direction as indicated in the Bouguer gravity map is also worthy of further investigation by seismic shooting.

Thanks are due to R. Aravamudhan, P. C. Das, B. Subrahmanyam and others, who assisted the author in the seismic surveys and to Y. R. Bhanumurthy, B. G. K. Murthy, A. K. Menon and others, who carried out the gravity and magnetic observations and the reduction of the field data.

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A LARGE RED-SHIFT

ASTRONOMICAL data concerned with more distant galaxies are of greater significance to cosmological theories than those relating to our own galaxy and its neighbourhood, although the latter are necessarily much more accurate and detailed. The new science of Radioastronomy enables one to probe to greater depths in space, and the strongest radio sources have been identified with distant galaxies. This provides a promising way of locating such galaxies that show strong emission lines in their spectra. Emission lines permit very large red-shifts to be measured.

The recessional velocities of distant nebulæ, which are proportional to their distances, are determined by measurement of the Doppler-shift of the absorption lines in their spectra. However, the absorption features of faint nebulæ are veiled by the night-sky spectrum and Doppler-shift measurements of extragalactic nebulæ of apparent magnitude fainter than 19 are not ordinarily possible. Emission lines, however, remain visible for much fainter galaxies than absorption lines and can be used for their red-shift measurements.

Among the known radio sources discovered by radio-astronomy one has now been identified with a galaxy of apparent magnitude 21, which appears to be the brightest member of a cluster of galaxies. This shows a strong emission line at λ 5448 Å. The emission line is almost certainly the forbidden doublet of ionized oxygen, the laboratory wavelength of which is 3728 Å. Thus the large red-shift $\delta\lambda/\lambda$, corresponds to a velocity of 140000 km./sec. or 0·46 times the velocity of light (R. Minkowski, *Astrophys. J.*, 1960, **132**, 909). Baum using photoelectric photometry has found two fainter galaxies with Doppler-shift 0·44. Thus there is reason to believe that all the three galaxies are members of the same cluster.—(*Nature*, 1961, **189**, 713).

SUPERPOSABLE PICTURES OF CHROMOSOME STRUCTURE OF *ALLIUM CEP* IN FEULGEN AND HAEMATOXYLIN SQUASHES

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INTRODUCTION

THE hæmatoxylin squash method[1-3] gave elegant staining of the chromosomes and non-fading permanent preparations. The hydrolysis in N HCl at 60° C. for 10-12 min. prior to staining was reminiscent of a similar step in Feulgen procedure.[4] Cells stained with leuco-basic fuchsin gradually fade on keeping. If pictures obtained with hæmatoxylin are superposable on those of Feulgen it would be a permanent record of the observations.

While hæmatoxylin stains both acidic and basic structures, the Schiff's reagent colours only structures containing DNA. Sections of fixed material hydrolysed as for Feulgen but stained with hæmatoxylin show both the chromatin and nucleoli in slightly differing shades while a counterstain is necessary to reveal the nucleoli in Feulgen preparations. If it is the fixative which renders the nucleoli stainable with hæmatoxylin even after hydrolysis, then, avoidance of conventional fixatives should enable obtaining hæmatoxylin preparations where the nucleoli would remain unstained and the details of chromosome structure and configuration superposable on those stained by the Feulgen technique.

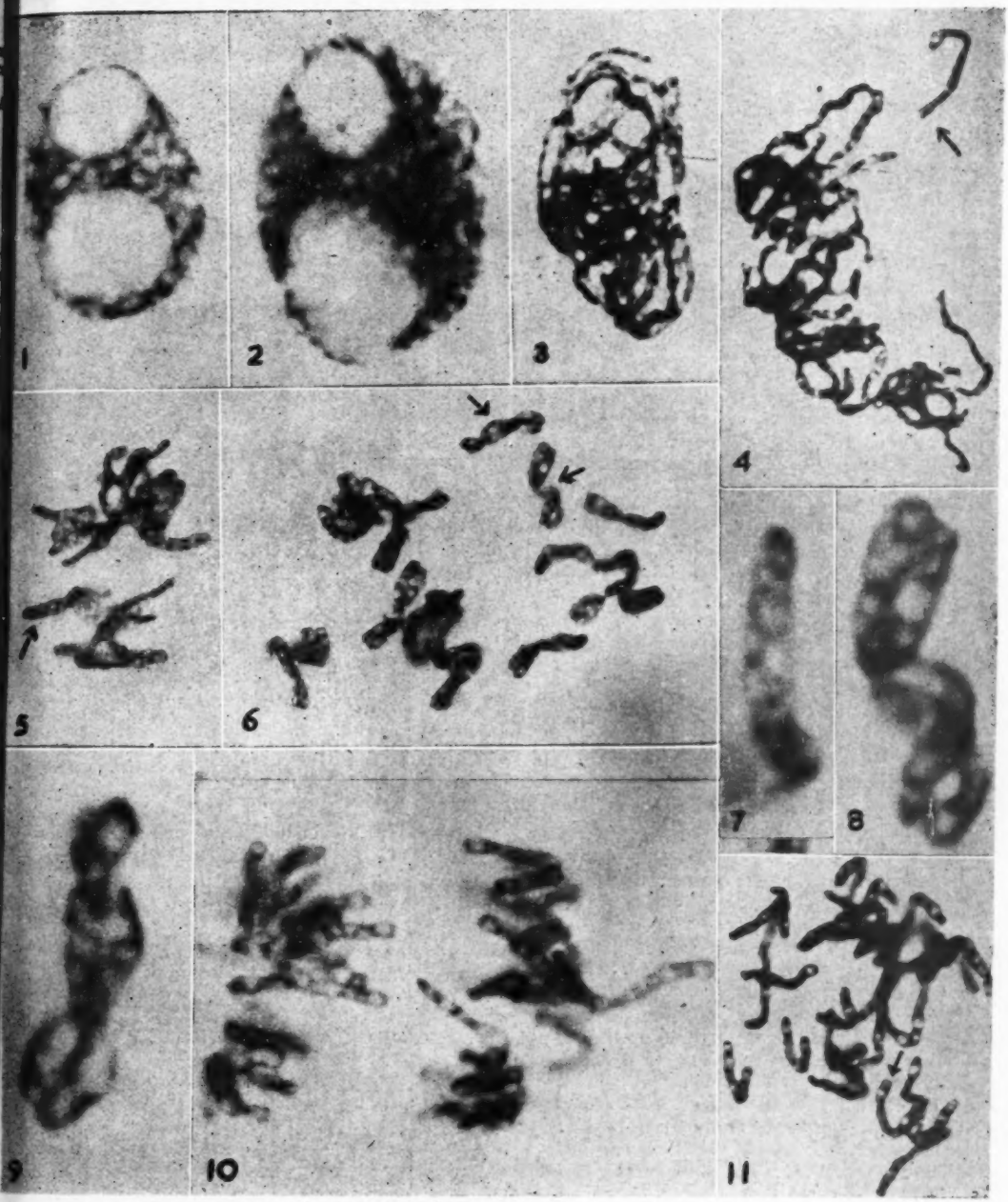
The most obvious procedure is to employ N HCl at 60° C. as the medium for fixation as well as hydrolysis.[5] Fresh roots of *Allium cepa* exposed for 8 min. to hot HCl were washed in distilled water and stained either with leuco basic fuchsin or with Heidenhain's hæmatoxylin. For Feulgen staining, the washed roots were transferred to leuco-basic fuchsin and kept in the dark for 3 hrs. After a wash in three changes of SO_2 water for a total duration of 30 min. they were rinsed in distilled water and squashed in 45% acetic acid under a coverslip. The slides and coverslips used should be coated with a thin layer of Mayer's albumen and then flamed. When the spreading of the cells appeared satisfactory, the coverslips were released in 40% alcohol. They were dehydrated in ascending grades of alcohol, then cleared in xylol and mounted in Canada balsam. Some of the material was counterstained with aqueous light-green. The procedure for making hæmatoxylin squashes was essentially the same as described previously.[1]

Since there is a slight increase in the intensity of the stain when made permanent, the cells in the squash should be destained to a stage lighter than actually desired. This could be achieved by the control of the time of stay of the stained material in 45% acetic acid before squashing. The preparations could be made permanent by dehydration with either ethyl or tertiary butyl alcohol. When the latter is used, they could be mounted direct in Canada balsam dissolved in butyl alcohol. The use of ethyl alcohol necessitates clearing in xylol before mounting in Canada balsam.

OBSERVATIONS

The resting nucleus has a reticulated appearance in Feulgen (Fig. 1) as well as hæmatoxylin (Fig. 2) preparations and the areas occupied by the nucleoli appear unstained. The structural details of the chromosomes during the various phases of the division cycle are also superposable (Feulgen—Figs. 3, 5, 7 and 10; hæmatoxylin—Figs. 4, 6, 8, 9 and 11). During prophase, the chromosomes appear to consist of two chromatids and the free ends of one such pair are indicated by an arrow in Fig. 4. The general impression one gets is that the chromatids are relationally coiled.

The most unexpected discovery was that while the two chromatids of the metaphase chromosome showed relational coiling (Figs. 5, 8 and 9), each chromatid itself appeared linearly vacuolated reminiscent of descriptions of coiling of a pair of chromonemata.[6,7] In other words, the appearances are suggestive of a quadri-partite structure of the metaphase chromosome.[8] It need hardly be mentioned that hæmatoxylin pictures were superior to those of Feulgen in their clarity for demonstration of the relational coiling of the chromatids as well as the coiled pair of chromonemata. This is exemplified by enlargements of individual chromosomes (Figs. 7, 8 and 9) indicated by arrows in Figs. 5 and 6. At anaphase the daughter chromosomes show the same type of configuration as exhibited by the individual chromatids at metaphase. The free ends of the two chromonemata of an anaphase chromosome are indicated by an arrow in Fig. 11. The coiling of the chromonemata at meta- and anaphases appears to be of the caduceus type.[9]



FIGS. 1, 3, 5, 7 and 0. Direct N HCl-Feulgen Squash. Fig. 1. Resting nucleus, × *ca* 2,500. Fig. 3. Prophase showing the spiral structure. × *ca*. 1,500. Fig. 5. Metaphase. One chromosome shows the quadri-partite structure, × *ca*. 1,500. Fig. 7. Enlargement of the chromosome arm indicated in Fig. 5. × *ca*. 6,000. Fig. 10. Anaphase. Most of the chromosomes consist of a pair of caduceusly coiled chromonemata, × *ca*. 2,900.

FIGS. 2, 4, 6, 8, 9 and 11. Direct N HCl-Iron Hæmatoxylin Squash. Fig. 2. Resting nucleus. × 2,500. Fig. 4. Prophase. Compare with Fig. 3. Arrow indicates the bifid end of a chromosome. × *ca*. 1,500. Fig. 6. Metaphase. The chromatids show relational coiling. Each chromatid is composed of a pair of chromonemata, × *ca*. 1,500. Figs. 8 and 9. Enlargements of two of the chromosomes indicated by arrows in Fig. 6. Note the relational coiling and quadri-partite structure, × *ca*. 6.000. Fig. 11. Anaphase. The free ends of one pair of chromonemata are indicated by an arrow, × *ca*. 1,500.

Discussion

Squash techniques obviate the use of conventional fixatives so necessary to render a root suitable for serial sectioning. It is this advantage which enabled devising a procedure by which the details shown by hæmatoxylin would only be those that are seen after Feulgen. Unexpectedly, the new method revealed also the structural details of the chromosomes during the various phases of mitosis. This was not very surprising since one of the methods used for revealing the spiral structure is exposure to fumes of concentrated HCl.[7,8,10,11] But exposure to acid fumes was only a pretreatment which was followed by preservation in various fixatives. Accurate control of the pretreatment is rather difficult. A clear evaluation of the action of fixatives after such pretreatment is not also easy. These limitations are minimised in the new technique devised. The temperature and time of hydrolysis in N HCl of fresh roots could be controlled and there is no subsequent fixation. The results obtained are, therefore, easily reproducible.

Though the first description of the chromosome spiral by Baranetzky in 1880 was from damaged living cells, a wide variety of agencies have been used to improve its clarity for purposes of analysis.[11] Naturally, the spiral thus demonstrated is a vital artefact. The figures presented show that the same details of chromosome structure are seen in hæmatoxylin and Feulgen preparations. But then, the agency producing the clarity of structural details is not the stains but the use of N HCl at 60° C as the medium for fixation and hydrolysis.

The chromosome matrix appears Feulgen negative, the chromonemata alone being Feulgen positive. The clarity of pictures in which the free ends of the chromonemata lie separated (Fig. 11) suggests that the pairs of chromonemata are enclosed within a pellicle.[12] Other methods of approach are now being explored to evaluate whether the configuration of the coiling of the chromonemata is similar after pretreatment with different agencies and whether clear proof would be available for the presence of a pellicle.

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INDIA'S POPULATION ACCORDING TO 1961 CENSUS

PRELIMINARY figures of the population of India according to the census of February-March 1961 were published recently. (The figures for Manipur, Nagaland, and North-East Frontier Agency are not included.) The total population is 436,424,429, out of which 224,957,948 are males and 211,466,481 are females. The increase in population over the figures for 1951 is 77,207,524. This means that during the decade 1951-61 the population has increased by 21·49%. This growth is 61% faster than the rate at which the population grew between 1941-51 which was 13·34%. Out of the 436 millions, the rural population is 358 millions or 82% and the urban population is 78 millions or 18%.

Indian Union has an area of 1,127,345 sq. miles. The density of population is 384 per square mile as against 316 in 1951. Regarding sex-ratio, the number of females per 1,000 males is 940, as against 946 in 1951.

The distribution of population amongst the 15 States of the Union, and the percentage increase during the decade 1951-61 are shown in the following table.

Table I

States	Area (in 1000 sq. miles)	Population (in millions)	Percentage increase over 1951 figure
Andhra Pradesh ..	106·0	35·98	15·63
Assam ..	47·1	11·86	34·30
Bihar ..	67·2	46·46	19·78
Gujarat ..	72·1	20·62	26·80
Jammu and Kashmir ..	..	3·58	9·73
Kerala ..	15·0	16·88	24·55
Madhya Pradesh ..	171·2	32·39	24·25
Madras ..	50·1	33·65	11·73
Maharashtra ..	118·9	39·50	23·44
Mysore ..	74·1	23·55	21·36
Orissa ..	60·2	17·57	19·94
Panjab ..	47·1	20·30	25·80
Rajasthan ..	132·2	20·15	26·14
Uttar Pradesh ..	113·5	73·75	16·67
West Bengal ..	39·9	39·97	32·94

LETTERS TO THE EDITOR

APPLICATION OF THEORY OF IRREVERSIBLE POLAROGRAPHIC WAVES TO THE REDUCTION OF BRILLIANT GREEN AT THE DROPPING MERCURY ELECTRODE

In recent years various theories[1-5] have been developed for elucidation of polarographic irreversible reduction processes which are not governed by the familiar Heyrovsky-Ilkovic equation.[6,7] Of these, the mechanism put forward by Delahay[4,5] assumes that the electrode process is controlled by (*a*) rate of diffusion and (*b*) rate of chemical reaction preceding or following the electrode process.[8] The present article reports the applicability of Delahay's theory to the reduction of brilliant green (B.G.), *viz.*, 44′ bisdiethyl amino-triphenyl methyl chloride at the dropping mercury electrode (dme).

Brilliant green of medicinal quality was purified by the partition methods of Lewis, Magel and Lipkin.[9] Potassium nitrate used as a supporting electrolyte was B.D.H. 'Analar' sample. Polarographic measurements were carried out with a manual polarograph described elsewhere[10]; the capillary employed had the characteristics: $m = 1{\cdot}462$ mg. sec.$^{-1}$; $t = 2{\cdot}564$ sec. All polarograms were taken in deoxygenated solutions. Methyl cellulose solution (·02%) was used as maximum suppressor.

Preliminary experiments showed that the polarograms of B.G. in aqueous solutions were highly distorted in accord with the data of earlier workers.[11] Use of 50% alcohol-water mixture resulted in the production of well-defined stable polarograms. Figure 1 gives a typical polarogram indicating two-step reduction of B.G. at dme, with $(E_{\frac{1}{2}})_1 = -0{\cdot}37$ and $(E_{\frac{1}{2}})_2 = -0{\cdot}77$ volt *vs.* SCE. Computation of the number (n) of electrons involved in the reduction process, from log $\frac{i}{i_d - i}$ *vs.* E plots was not possible. It could however be determined from Ilkovic's equation,[12] which required the use of the data on the diffusion coefficient D of B.G.; D was determined in separate experiments using McBain and Dawson[13] cell. D for B.G. corresponded to $1{\cdot}142 \times 10^{-6}$ cm.^{2} sec.$^{-1}$ under polarographic conditions. These data gave $n = 1$ for both the reduction waves (Fig. 1).

Employing the value of n and D the values of the rate constant k of the irreversible process were evaluated[5] from the data in Fig. 1.

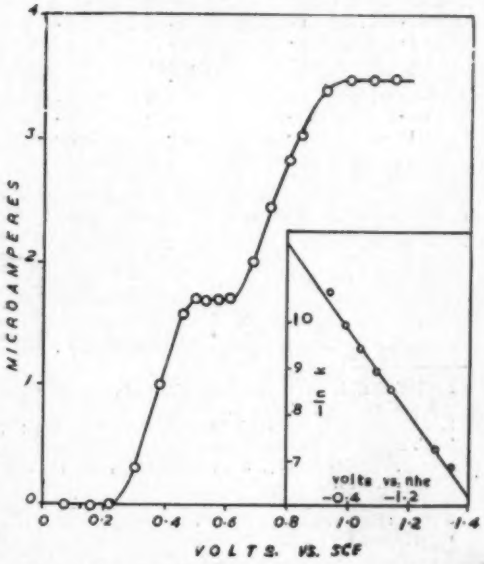

Fig. 1. Irreversible polarographic reduction of brilliant green.

These results are given in Table I. It is of interest to note that k is $2{\cdot}67 \times 10^{-5}$ cm. sec.$^{-1}$ at $E = -0{\cdot}018$ volts *vs.* N.H.E. at 25° C., which indicates the slow nature of the *electrode reaction* leading to the irreversible nature of the reduction process. Data in Table I show that k is markedly dependent on applied potential E. The variation of k with E is governed by the equation

$$\ln k = \ln k_0 - \frac{n\alpha FE}{RT} \qquad \text{(1)}$$

In accord with Equation 1 $\ln k$ is linearly variant with E (*see* inset Fig. 1) suggesting the applicability of Delahay's theory to the irreversible reduction of B.G. at dme. The slope of the plot, $\ln k$ *vs.* E, gives a value of 0·59 for α, which is defined as the fraction of the potential favouring the cathodic reaction. Further, the data gave a value $1{\cdot}92 \times 10^{-5}$ cm. sec.$^{-1}$ for k_0 for the rate constant at $E = 0$.

TABLE I

Determination of the rate constant of irreversible reduction of brilliant green

Concentration of B.G. = 1·70 *m*M
Concentration of KNO_3 = 0·1 M

Applied potential Volt *vs.* N H.E.	Current μA	$\beta kD^{-\frac{1}{2}} \times 10^2$	$k \times 10^5$
−0·018	0·085	1·58	2·67
−0·038	0·160	2·94	4·69
−0·058	0·260	4·76	8·55
−0·078	0·425	7·72	14·10
−0·098	0·600	10·90	20·31
−0·118	0·775	14·40	28·21
−0·158	1·125	20·44	74·80

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OXIDATION OF THIOCYANATE WITH CHLORAMINE-T

THE sulphur in potassium thiocyanate is known to get oxidised to sulphuric acid by several oxidising agents such as bromine,[1] hypohalite,[2] iodine,[3] iodate[4] and hydrogen peroxide.[5] Recently the kinetics of the oxidation of thiocyanate by hydrogen peroxide has been studied and it is reported that the reaction is independent of the pH of the medium.[5] Chloramine-T has been observed to bring about rupture between S–S, N–S[6] and C–S[7] linkages and oxidise all the sulphur to sulphuric acid in an acid medium. It was of interest to study the oxidation reaction between thiocyanate and chloramine-T and the results of such an investigation are reported in the present communication.

The following solutions were prepared with chemicals of high grade purity and their strength estimated by standard methods.

(1) Decinormal chloramine-T[8]; (2) Decinormal potassium thiocyanate[9]; (3) Decinormal sodium arsenite; (4) Decinormal sodium thiosulphate; (5) Standard buffers of pH lying between 2 and 13.[10]

Procedure.—A known excess of chloramine-T solution (10 ml.) was mixed with 10 ml. of hydrochloric acid (1 N) or any of the buffer to which a known amount of potassium thiocyanate was added (0·5 ml. to 2 ml.). The reaction mixture was shaken occasionally and allowed to stand for about half an hour. The excess of chloramine-T was then estimated by the addition of 10 ml. of potassium iodide solution (10%), and titrating the iodine liberated against thiosulphate solution. In the alkaline medium the excess of oxidising agent was treated with a known excess of sodium arsenite solution and the excess of arsenite was estimated by titrating with a standard iodine solution after acidifying and removing the excess acid by an excess of sodium bicarbonate solution. From the titre values it was possible to calculate the number of equivalents of oxidant consumed by a mole of thiocyanate. The results of a few representative experiments are presented in Table I.

It can be seen from the results of the table that in an acid medium, every mole of thiocyanate consumes eight equivalents of chloramine-T whereby all the sulphur is converted to sulphate in terms of the equation

$$SCN^- + 4O + H_2O + H^+ \rightarrow HOCN + H_2SO_4.$$

At and above pH 7, the oxidation is not complete and it becomes extremely sluggish. Only a part of the thiocyanate seems to get oxidised between pH 8 and 13. At pH 13, there is practically no oxidation of the thiocyanate even if the reaction is allowed to take place for over 24 hours. Even after warming at 40° C. for one hour very little oxidant was consumed by the thiocyanate. However warming the reaction mixture at 40° C. for one hour at pH 7 resulted in the quantitative oxidation of the thiocyanate (Expt. No. II).

It is clear from the above results that C–S linkage in thiocyanate can be broken and all the sulphur is oxidised to sulphuric acid

TABLE I

Oxidation of thiocyanate by chloramine-T

Expt. No.	pH of the medium	No. of moles of KCNS taken for the expt. $\times 10^{-5}$	No. of equivalents of oxidant consumed $\times 10^{-5}$	No. of equivalents of oxidant consumed per mole of thiocyanate
1	less than 0·1	5·48	43·91	8·01
2	,,	10·96	88·51	8·07
3	,,	16·44	131·20	7·98
4	,,	21·92	174·00	7·94
5	2	5·48	43·91	8·01
6	3	5·48	43·91	8·01
7	4	5·48	43 91	8·01
8	5	5·48	43·91	8·01
9	6	5·48	43·91	8·01
10	7	5·48	34·65	6·32
11	7	5·48	43·91	8·01 (After warming)
12	8	5·48	23·64	4·31
13	9	5·48	28·46	5·19
14	10	5·48	30·53	5·57
15	13	5·48	7·11	1·29
16	1 N NaOH (10 ml.)	5·48	9·65	1·76

quantitatively. The method could be employed to estimate thiocyanate in an acid medium.

The authors wish to express their grateful thanks to Professor M. R. A. Rao for his keen interest in the work.

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INCREASED FIBRE CONTENT IN HEMP (*CANNABIS SATIVA*) AND SUNN (*CROTALARIA JUNCEA*) BY APPLICATION OF GIBBERELLINS

STEM elongation in plants is the most characteristic response to gibberellin application and this was, until recently,[1] believed to be the result of cell elongation. More recently it has been shown that gibberellin causes both increase in length and in number of cells[2-5] in the epidermis, cortex and pith. The effect of gibberellin on the hemp and sunn plants studied here has shown that gibberellin enhances the height and diameter of the stem as well as number, length and thickness of lignified fibres.

Ten hemp plants with 2-3 internodes were sprayed with a 100 p.p.m. aqueous solution of gibberellin on three successive days initially and then sprayed at weeky intervals for six weeks, when the treated and control were compared with respect to their fibre characteristics. The results are recorded in Table I.

In case of 'sunn' two plots of about 80 plants each were grown. To one of these, application of gibberellin was made when 2-3 week old and subsequently at weekly intervals for about 2 months. One month after the last application, the plants of the treated plot as well as the control were harvested. The height and basal diameter of all the plants were recorded. The individual fibres were isolated by maceration and their lengths measured. The diameter of the fibres was determined from the transverse section of the stems using a micrometer. Equal number of treated and untreated plants were subjected to retting process and the yield of fibre per plant was calculated from the data so obtained. The results are recorded in Table I.

In another set of experiment sunn seeds were sown in two plots of 4′ × 12′ each. The plants in one of these plots were divided into 4 groups of about 20 plants each. Gibberellin (Pfizer) was applied in the form of a foliar spray of 100 ppm. aqueous solution containing ½% gum acacia as a surface active agent. To the first group the application of gibberellin was made one week after sowing, to the second group 2 weeks after sowing, to the third group 3 weeks after sowing while the fourth group as well as the plants in the second plot were kept as controls. These applications were continued at weekly intervals, for a period of eight weeks. The height of the plants was recorded at the time of each application and is shown in Fig. 1.

The third group to which application was made three weeks after sowing the seeds showed maxi-

TABLE I

Quantitative effect of Gibberellin on the fibres of Crotalaria juncea *and* Cannabis sativa

Character	Treated				Untreated						
	Number of readings	Mean	Variance	S.D.	Number of readings	Mean	Variance	S.D.	'*t*'	d.f.	1% of *t* value
Crotalaria juncea											
Length of fibres in cm.	25	1·04	0·0316	0·1778	21	0·452	0·005	0·0707	14	44	less than 2·75
Diameter of fibres in μ	24	39·5	54·1	7·3553	25	24·7	29·4	5·4222	7·8	47	,, 2·75
Length of stem in cm.	50	258·6	454·7	21·324	66	223·4	483	21·977	8·54	114	,, 2·75
Basal diameter of stem in mm.	41	1·2	0·144	0·3795	62	0·68	0·1013	0·3183	7·4	101	,, 2·75
Yield of fibre per plant in g.	..	2·83	..	..	..	1·93	..	..	..	..	..
Cannabis sativa											
Fibre diameter ..	16	24	8·44	2·9052	16	18	6·25	2·5	6·06	30	less than 2·75
Fibre wall thickness ..	15	7·6	0·82	0·9055	15	4·7	0·600	0·774	9·2	28	,, 2·75
Fibre length in cm. ..	18	3·8	0·200	0·4472	20	0·43	0·04	0·2	29	36	,, 2·75
Bark/wood ratio fresh ..	..	0·37	..	..	..	0·33	..	..	..	..	..
Bark/wood ratio dry ..	..	0·53	..	..	..	0·51	..	..	..	..	..

mum, the second group less and first group the least gain in height showing thereby that the best effects are produced when gibberllin application is started on plants which are 3 weeks

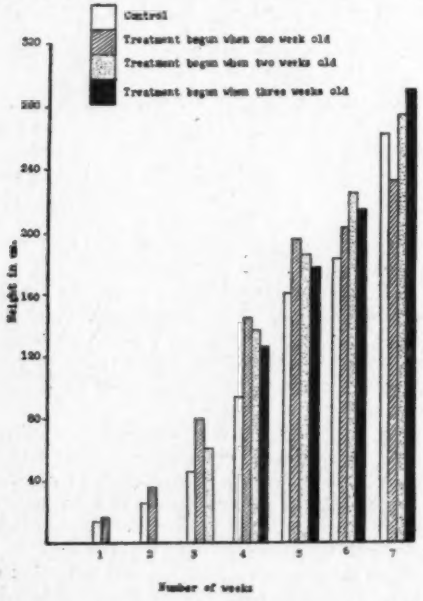

FIG. 1

old, while the plants on which gibberellin application was started when one week old, there was an inhibitory effect on the height as compared to the controls.

The gibberellin treated hemp plants recorded increase in the average length, diameter and wall thickness of the individual fibres and an increased number of fibres over control plants. The treated plants showed a higher bark/wood ratio which is a desirable criterion[6] in fibre-yielding plants. Treated hemp plants showed a complete lack of lateral branching which also is a desirable feature.[7] The data given in Table I reveals that gibberellin application causes a definite increase in the stem height and diameter, fibre length and diameter and overall yield of fibres in case of sunn plants. The differences in the mean values for the different characteristics for the treated and untreated plants, as tested by means of the "*t*"-test, show that all the *t* values are very highly significant, being much larger than the 1% values. This confirms the hypothesis regarding the effect of gibberellin. The gibberellin induced increase of fibres in sunn is not as outstanding as in the case of hemp. However, the results obtained suggest that gibberellin may offer commercial possibilities in the natural fibre industry.

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SOME 2-STYRYL DERIVATIVES OF 4(3)-QUINAZOLONES AS POTENTIAL ANTIMALARIALS AND AMOEBICIDES

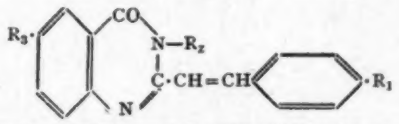
EARLIER in this series, synthesis of variously substituted 2-alkyl-3-aryl (or substituted sulphonamido-phenyl)-6-halo (or alkyl)-4(3)-quinazolones have been reported as potential antimalarials.[1,2] A few 2-methyl-3-aryl-4(3)-quinazolones have also been reported to be active against *P. gallinaceum* in chicks.[3-5] However, not much work seems to have been done regarding the potentiality of 2-styryl-4(3)-quinazolone derivatives as antimalarials. Recently some 3-substituted-8-hydroxy (or methoxy)-4(3)-quinazolones,[6] and 3-alkyl-2-styryl-8-hydroxy (or methoxy)-4(3)-quinazolones[7] have been reported as potential amœbicides.

It was thus considered worthwhile to synthesise 2-styryl-3-aryl-6-halo (or alkyl)-4(3)-quinazolone derivatives and study their antimalarial and amœbicidal properties (Table I).

Most of the desired 2-methyl-3-aryl-6-halo (or alkyl)-4(3)-quinazolones have been synthesized according to the general methods of Bami and Dhatt[1] and other workers.[5,8] Normally, 2-styryl-3-aryl-6-halo (or alkyl)-4(3)-quinazolones were obtained in good yield by refluxing for 7–8 hours different 2-methyl-3-aryl-6-halo (or alkyl)-4(3)-quinazolones with an excess of benzaldehyde or *para*-anisaldehyde without employing any condensing medium. Whereas in case of condensations of 2-methyl-3-aryl-6-halo (or alkyl)-4(3)-quinazolones with *p*-dimethyl-amino-benzaldehyde, only equivalent quantities were heated at 180–90° C. for 7–8 hours. These compounds (Table I) got separated on diluting the reaction mixture with ethanol, followed by cooling in an ice-bath. They were crystallised from ethanol-benzene mixture as pale to lemon-yellow granules or needles. Antimalarial activity of these compounds against *P. gallinaceum* in chicks was tested according to the method of Jaswant Singh *et al.*[10,11] These compounds were found to be inactive at 4 times the quinine equivalent dose (Table I). However, some of these compounds showed promising results when tested *in vitro* for their amœbicidal activity against E.A. strain of *Entamœba histolytica*[12] (Table I). Further work is in progress.

TABLE I

2-p-substituted styryl-3-aryl-6-alkyl (or halo)-4(3)-quinazolones



S. No.	MIS	R_1	R_2	R_3	M.P. °C. Uncorrected	Molecular formula	Analysis-N % Required	Analysis-N % Found	Antimalaria activity at 4Q	*In vitro* minimal amœbicidal concentration (μg./ml.)
1	447	H	*p*-bromophenyl	H	219	$C_{22}H_{15}BrN_2O$	6·95	6·89	Nil	100
2	467	OCH_3	*p*-phenetyl	H	181	$C_{25}H_{22}N_2O_2$	7·03	7·41	Nil	10(?)*–100
3	406	$N(CH_3)_2$	*m*-tolyl	H	190	$C_{25}H_{23}N_3O$	11·02	11·25	Nil	100–>100
4	456	H	*p*-phenetyl	CH_3	205	$C_{25}H_{22}N_2O_2$	7·33	7·70	Nil	10(?)*–100
5	461	OCH_3	*p*-phenetyl	CH_3	191	$C_{26}H_{24}N_2O_3$	6·80	7·10	Nil	100
6	449	$N(CH_3)_2$	*p*-bromophenyl	CH_3	258	$C_{25}H_{22}BrN_3O$	9·13	9·28	Nil	>100
7	431	H	Phenyl	Cl	236	$C_{22}H_{15}ClN_2O$	7·81	7·36	Nil	100
8	443	OCH_3	*p*-anisyl	Cl	210	$C_{24}H_{19}ClN_2O_3$	6·69	7·02	Nil	100
9	451	$N(CH_3)_2$	*o*-chloro-phenyl	Cl	237	$C_{24}H_{19}Cl_2N_3O$	9·63	9·48	Nil	>100
10	420	H	*p*-anisyl	Br	211	$C_{23}H_{17}BrN_2O_2$	6·47	6·87	Nil	100–>100
11	428	OCH_3	*o*-anisyl	Br	235	$C_{24}H_{19}BrN_2O_3$	6·05	6·21	Nil	100
12	408	$N(CH_3)_2$	*o*-tolyl	Br	255	$C_{25}H_{22}BrN_3O$	9·13	9·34	Nil	10(?)*–100

* There were some indications of amœbicidal action at 10 μg./ml. But, however, there was no complete kill of amœba at this concentration.

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CRYPTOCOCCUS NEOFORMANS FROM PATIENTS IN POONA

THERE have been only very few reports of the occurrence of cyptococcosis in India, chiefly due to lack of diagnosis based on cultural studies. Sinha and Barua[1] reported cryptococcal meningitis in India and many of the suspected cases have remained unrecorded due to lack of isolation of causal organism. An account of two cases of cryptococcosis from Sassoon Hospitals, Poona, is presented in this note.

Studies were made in two patients admitted to the hospital with low grade fever, and cough. One of them was treated with chloromycetin resulting in the lowering of body temperature to normal, but with the continuation of cough and expectoration. Repeated examination for acid fast bacteria was negative, but flouroscopy revealed bronchovascular markings and emphysema. Microscopic examination and cultural study of the bronchoscopic aspirations revealed the presence of *Cryptococcus neoformans*. (Sanf.) Vuill.

The second case was a child, 6 years old (male) with severe pain in head and neck, and suspected for tubereular meningitis. Intermittent fever, severe cough and slight loss of vision were other symptoms noticed. Microscopic examination of the bronchoscopic aspirations, stained with India ink, showed *Cryptococcus neoformans*, with characteristic mucinous capsule 3–6 μ in diameter. Centrifuged cerebrospinal fluid also showed the same organism.

The causal organisms in both cases were cultured on Sabouraud's agar, and comparative morphological and cultural studies were carried out with an authentic culture of *Cryptococcus neoformans*. Animal inoculations were made in 6 weeks' old mice weighing 25–28 gm. They were inoculated intracerebrally with 0·3 ml. of spore suspension. All the 3 mice inoculated with the spore suspension died between 10 and 15 days, while the controls remained alive. A routine cultural study in cases of meningitis (where the blood and cerebro-spinal fluid are negative for bacterial pathogens) may reveal more cases of cryptococcosis in India, which usually escape detection.

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ROLE OF PLANTS IN THE MOVEMENT OF PHOSPHORUS BY RADIOACTIVE ISOTOPIC STUDIES

IT is generally believed that phosphorus is immobile in soils.[1,2] If this were so, continuous crop growth without adequate addition of phosphatic fertilizers should deplete the content of phosphorus in surface soils irrespective of its distribution in subsoils. However, it was observed[3] that continuous growth of legumes showed a tendency to increase the surface soil phosphorus. This has shown the possibility of tapping the subsoil phosphorus through suitable crop rotations and reduce the fertilizer need as regards phosphorus. In order to find out whether the leguminous plants can transfer nutrients from one zone to the other, the following experiment was devised.

Seedlings of ladino clover were raised in a medium of vermiculite moistened with the complete nutrient solution of the following composition with respect to major elements; Ca-78 ppm.; Mg-42 ppm.; NH_4-54 ppm.; K-233 ppm.; SO-170 ppm. and P-62 ppm. This was supplemented with the necessary minor elements. When the seedlings were one-month old the plants were carefully removed from the medium with the roots intact and washed with distilled water. The root systems of four plants were equally divided into two portions 'A' and 'B' equal also in respect of each plant. In the

first set, the portion 'A' was dipped in sand moistened with the above complete nutrient solution containing 62 ppm. phosphorus while the other portion 'B' was dipped in a tube containing only distilled water. The nutrient solution in the sand portion could be renewed every alternate day after drawing off the residual solution through an opening at the bottom fitted with a stop-cock. In the second set, plants were kept similarly except that the nutrient solution in 'A' contained no phosphorus as control. In a third set, 30 ml. of tagged P^{32} of 6 μc specific activity in the form of calcium mono-phosphate, amounting to a total of 60 mg. of phosphorus was added in the 'A' portion after 7 days of the growth under the conditions of the first set. First and second sets were replicated twice. After 15 days the portions in 'B' were carefully removed, filtered with glass wool and made up to 100 ml. In the case of treatment having P^{32}, an aliquot of 2·5 ml. was dried and the activity count was taken in an end window counter of the tracer lab scaler, under the identical geometrical conditions as that for the original solution. The calculations for the phosphorus transferred were made after deducting for the background. The phosphorus in the remaining sets containing ordinary phosphorus was estimated by the Dickman and Bray's colorimetric procedure.[4]

The results obtained are as follows :—

TABLE I

Amount of phosphorus transferred from one root zone to another

	Treatment in the 'A' portion of the root zone	Phosphorus in micrograms transferred in the distilled water surrounding the root system in 'B'
1	Nutrient Solution with P at 62 p.p.m.	15
2	do. ..	15
3	do. for one week with 60 mg. of P^{32} tagged mono-calcium phosphate (time of contact of P^{32} solution with roots—7 days)	7,305
4	Control (nutrient solution without P)	Nil
5	do. ..	Nil

The above evidence shows that plants can act as medium of transfer of phosphorus from one part of the rhizosphere to another. While possibility exists that the amount of phosphorus found in zone 'B' in the experiment without radioactive P^{32} could either have been transferred from portion 'A' or from the roots in 'B', there is no ambiguity in the experiment using radioactive phosphorus because the radioactive phosphorus was included only in the portion 'A' and not either in the roots or solution of portion 'B'.

Thus it appears possible to use suitable plants in rotation as media for transfer of subsoil phosphorus to the surface and thereby reduce the phosphatic fertilizer needs of surface soil.

Thanks are due to Dr. J. Hanway, Associate Professor of Soils, for giving the author necessary facilities for this work at Iowa State College, U.S.A.

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New Delhi-12, *January* 6, 1961.

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ABO BLOOD GROUPS IN THE RAJ GONDS

A PARTY belonging to the Department of Anthropology, Government of India, Calcutta, and under the leadership of Shri S. R. Das, Anthropologist of the aforesaid department, carried out a Genetic Survey among the Mahars of Nagpur district in 1958. The author as a member of the party while conducting the investigation in the Mahar community of Kamptee town, Nagpur district, tested the blood specimens of the Raj Gonds living in the same town.

The town of Kamptee is situated in 21° 13' N and 79° 12' E and 10 miles away from Nagpur city.

Fifty-one unrelated Raj Gonds were tested for ABO groups. As no published blood group data on this people are available, the present material, although small, may give some information about the ABO gene composition of this population. Gene frequency has been evaluated according to the improved formulæ of Bernstein (1930) cited by Race and Sanger[1] (1954). The results are given in Table I.

TABLE I

ABO blood groups in the Raj Gonds of Kamptee town

Groups	Observed No.	Expected No.	Observed p.c.	Gene frequency	D/σ
O	14	14·46	27·45	p=0·105	+0·921
A	7	6·25	13·73	q=0·362	
B	27	26·41	52·94	r=0·533	
AB	3	3·88	5·88	..	
Total	51	51·00	100·00	1·000	..

A very close agreement between the observed and the corresponding expected numbers of each phenotype and the D/σ value (+ 0·921) indicate the consistency of the data and the homogeneity of the sample.

Dept. of Anthropology, P. N. BHATTACHARJEE.
Govt. of India, Indian Museum,
Calcutta-13, *February* 18, 1961.

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"UREA-FORM"—A NEW FERTILISER

THE need for water-insoluble nitrogen that will release available nitrogen at rates approximating crop needs has been recognised. Natural "organics" have been used to meet this need but are not of much value in two respects. First most of the (available) nitrogen is converted to mineral form in a relatively short time. Second a very substantial percentage of the total nitrogen is not available (Yee and Love, 1946).[1] Furthermore most of the better grades of natural organics are used for livestock feed rather than for fertilizers and the unit price of nitrogen in natural organics is high. These considerations indicate the need for synthetic water-insoluble nitrogenous fertilizers with controlled rates of availability.

The alternative source of slowly available nitrogen is the "urea-form" which is the name assigned to the urea-formaldehyde reaction products. These products have high percentage of nitrogen (37–41%) depending upon the mole ratio of the reactants. As the mole ratio of the reactants is brought higher than unity, the solubility as well as the availability of the nitrogen of the products increases. The development of these suitable organic materials offers the possibilities of greater uniformity of the products. Still further interest would be a range of graded products having different rates of decomposition in the soil. The fertilizers could thus be selected to suit a particular crop.

There are several procedures for the preparation of urea-formaldehyde. Clark, Yee and Love (1946)[2] and Oven (1946)[3] have followed the method of reacting concentrated solution of urea with formaldehyde maintained at a suitable pH. The reaction is quite rapid and a lot of heat is evolved. The reaction product is a solid mass which can be dried and powdered. In the present work the procedure of the above workers was adopted. A list of the urea-formaldehyde compounds prepared in the laboratory is given in Table I.

TABLE I

Sl. No.	Fertilizer	U/F mole ratio	Nitrogen %
1	U.F.A. ..	6·75	41·82
2	U.F.B. ..	3·37	40·32
3	U.F.C. ..	2·23	38·72

The above products were subjected to the following tests for evaluating their slow acting nature.

(1) *Activity Index Test.*—This test applies only to urea formaldehyde compounds. This was carried out according to the procedure given in A.O.A.C. (1955).[5]

(2) *Pot Culture Experiment.*—Pots of 20 lb. capacity were used for conducting this experiment. They were filled with the surface soil obtained from Top Block A of Agronomy Division. Rice was grown during Kharif (1958) and the nitrogen was applied at the rate of 200 lb. N per acre.

In Table II are given yield data obtained in the case of rice crop. The data indicate that the effect of urea-formaldehyde on the yield of rice is as good as that of standard fertilizers urea.

TABLE II

Sl. No	Fertilizer	Replication 1	2	3	4	Average
1	Urea	68·00	66·00	69·50	74·00	69·30
2	U.F.A.	62·80	64·00	67·00	62·50	64·00
3	U.F.B.	65·50	86·50	65·90	72·00	72·40
4	U.F.C.	46·50	53·00	59·00	52·00	52·60
5	Control	16·00	16·00	19·70	18·00	17·40

C.D. at the rate of 5% — 27·53
C.D. at the rate of 1% — 38·60

The data were statistically examined and the results were found to be significant at 5% level. Urea and the other urea-formaldehyde reaction products, *e.g.*, U.F.A., U.F.B., and U.F.C. were found to give significant increase over no manure but they were found to be insignificant over one another. Such a behaviour was anticipated as these products have fairly high solubility and nitrifiability. The above observations are in conformity with the observations of Armiger *et al.* (1948).[4] They found that the rate at which the nitrogen becomes available for crop growth increases as the urea-form mole ratio increased. So it can be said that the urea-form products of higher U/F mole ratio are as efficient as standard fertilizer urea.

Indian Agricultural Research Institute,
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S. N. DATTA.
V. ISWARAN.
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VANADIUM-BEARING TITANIFEROUS MAGNETITES NEAR TIRUVUR, KRISHNA DIST., ANDHRA PRADESH

THE Eastern Singbhum and Nausahi in Keonjhar District of Orissa are the only places where the occurrence of Vanadiferous titaniferous magnetite ores has been reported. Dunn[1] described the different types of the magnetite ores of the former area ; Ghosh and Prasada Rao[2] reported on those of the latter area ; Mukherjee[3] and Chakravarti[4] have made a detailed mineragraphic study of the Nausahi ores.

The author had an occasion to study the iron ore bodies found near Kommireddipalle, a small village, 7 miles south-west of Tiruvur in Krishna District. These ores proved to be vanadiferous when they were analysed later in the laboratory.

The vanadium-bearing magnetite occurs as a dyke in the basic charnockites which are intrusive into the khondalites. The ore body is about 500 ft. long and 50 ft. wide striking N.N.W.-S.S.E. with an easterly dip of 80°. As a result of weathering the outcrop of the main lode has been disintegrated into massive boulders, loose and gritty material, float ores and placer sands. The existence of the dyke has been revealed by a detailed prospecting and magnetic survey.

Vanadium determinations have been carried out on all types of the ore and the percentages of vanadium pentoxide and titanium oxide are found to vary in different types of ores as shown below :

Type of ore	V_2O_5	TiO_2
Hard ore	1·875	13·60
Gritty ore	0·670	14·36
Soft ore	1·340	15·20
Float ore	1·785	13·80

The ores have been studied under the ore microscope. They consist of magnetite, ilmenite, hematite, maghemite, martite, rutile and goethite. No vanadium mineral is identified but both magnetite and hematite respond readily to the spot[5] and fluorescence[6] tests for vanadium. Vanadium may be occurring here as vanado-magnetite and vanado-hematite in solid solution with magnetite and hematite. Some important textures found in these ores are (1) crystallographic intergrowth of magnetite-ilmenite ; hematite-ilmenite ; (2) granular intergrowth of magnetite and ilmenite and (3) replacement textures.

The paragenetic sequence of the minerals from the earliest to the latest is : intergrown magnetite-ilmenite, ilmenite, maghemite, martite, hematite (β), goethite and rutile.

From a correlation of the mode of occurrence of the magnetite lode with the ore microscopic studies, it is suggested that the vanadium-bearing titaniferous magnetites of the Tiruvur area have originated through the process of late magmatic accumulation and injection.

The details of field and mineragraphic studies will be published elsewhere.

The author desires to express his grateful thanks to Prof. C. Mahadevan for many helpful discussions throughout the work.

Department of Geology, Andhra University,
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K. KAMESWARA RAO.

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KYUSHU EARTHQUAKE—GRAVITY RECORD AT HYDERABAD

IN an earlier paper,[1] the authors have drawn attention to how earthquake shocks influence a gravimeter spring. Since then, we have designed and set up an automatic recorder in this laboratory for recording the change in gravity value with time. The recording device is of an optical type where the light beam from an external source falls on the mirror of a moving coil galvanometer which is connected to the gravimeter. The variation in gravity with time as shown by the gravimeter is noticed by observing the movement of the galvanometer mirror, and this is recorded on a photographic paper round a drum driven by a clock-work mechanism. We are able to cover periods of 12 hours continuously at a time with this arrangement. The

record obtained on the night of 26/27 February 1961 (Fig. 1) shows a great disturbance at about 23 hours 50 minutes which gradually died out.

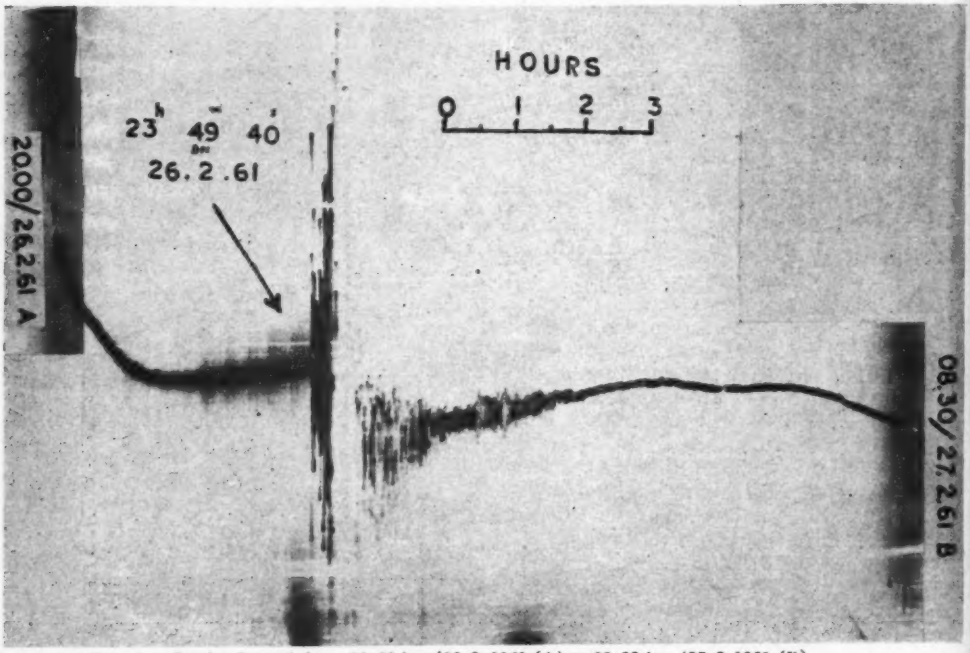

FIG. 1. Gravity Record from 20·00 hrs./26-2-1961 (A) to 08·30 hrs./27-2-1961 (B).

The seismic records (both N-S and E-W components) obtained from the Nizamia Observatory at Hyderabad (Fig. 2) indicate an intense earthquake that evening at the same time (23 hours 50 minutes). Available information tells us that the shock occurred at a distance of about 5,600 km. in a direction exactly 45° East of North, the epicenter of which was located off-shore South-East of Kyushu, the southernmost island of the Japanese group. The interesting point about the seismic records is the similarity between the two components inasmuch as the intensity is same in both and there is a marked correspondence in the phase of the record in both the components. This is presumably so because the earthquake occurred in a direction midway between North and East.

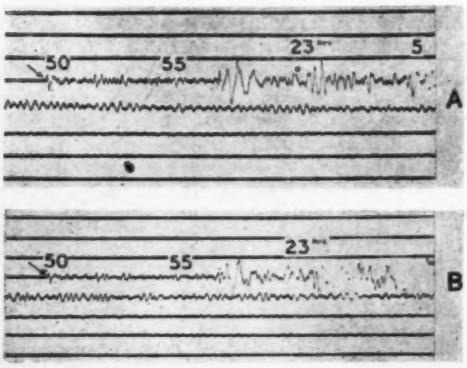

FIG. 2. Seismic Records. A. E-W Component and B. N-S Component arrows indicate first earthquake shock at 23 hrs., 49 mins., 40 secs. on 26-2-1961.

The gravity record shows other interesting features. In addition to the high frequency of great amplitude, a long-period vibration of a period slightly less than an hour (50-55 mins.) seems to be present in the curve besides a two-hour period. However, this can be confirmed only after complete analysis of the data. The striking feature of the observation is that the gravity record we have now obtained is at a station far removed from the epicenter. Both the seismic and gravity records stand nicely correlated and suggest that any disturbance due to an earthquake shock and presumably also

the long-period vibration of the earth may be recorded successfully.

A close examination of the gravity and seismic records obtained from neighbouring observatories with reference to particular earthquake will enable us to know the local geological structure. It appears also that the long-distance earthquakes can be made use of in a similar fashion for delineating the Mohorovicic layer in an area. All the above ideas and suggestions are shared by Prof. Masami Hayakawa of the Geological Survey of Japan who was present at Hyderabad when the record was obtained and the authors are grateful to him for the discussion they had with him.

A detailed analysis and the application of the data to the interpretation of the underground structure will be taken up later in a fuller communication.

Geology Department, S. BALAKRISHNA.
Osmania University, P. V. JOHNSON.
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NITROGEN CONTENT OF TWO SPECIES OF WOOD-BORING *MARTESIA* OF MADRAS

THE total nitrogen content of several Molluscs have been studied (Vinagradov[1] for earlier literature; Lasker and Lane[2]; Greenfield[3]) but systematic studies of particular species in relation to season and age are meagre except for those on *Teredo pedicellata* (Greenfield[3]). Greenfield[3] and Lasker and Lane[2] have reported that the nitrogen content of Teredines is low and that they derive their requirements both from wood and suspended planktonic organisms. It was felt that a comparative study of the nitrogen content in relation to size of the marine wood-boring pholads *Martesia striata* and *Martesia fragilis* not attempted before would be of interest.

Total nitrogen of *M. striata* and *M. fragilis* collected in the Madras coast were determined by the usual Microkjeldahl method (Steyermark[4]).

The total N of *M. fragilis* increases with increasing body weight, i.e., it is 0·1157 mg. in an animal weighing 3 mg. (wet weight) and gradually increases until it is 1·26 mg. in animals weighing 61 mg. (Fig. 1). This amounts to 3·85% to 2·06% of the wet weight. The unit nitrogen content shows a slight but gradual decrease with increase in body weight although there is considerable fluctuation. The dry matter was only a fifth of the total weight and on the basis of the dry weights the nitrogen content varied from 10·3% to 19·25%. In *M. striata* on the other hand the nitrogen content varied from 3·7 mg. in 94 mg. of tissue (3·93%) to 13·35 mg. in 534 mg. (2·28%). As in *M. fragilis* there is a fall in N content per unit weight with an increase in body weight.

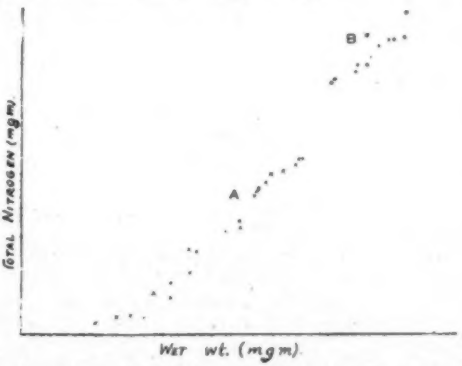

FIG. 1. Double logrithmic graph showing the Total N content of (A) *Martesia fragilis* and (B) *Martesia striata* in relation to their body weight.

M. striata which occurs in the piles and other fixed structures of the harbour possesses higher N content (mean values) than *M. fragilis* which is mainly a pelagic form. The mean N content of *M. striata* is 3·18% of living matter and 15·90% of dry matter and that of *M. fragilis* is 2·37% of living matter and 11·85% of dry matter. From the data, it is seen that the mean N content per unit weight of *M. striata* is about 1·34 times more than that found in *M. fragilis*. The N values of the wood-boring Teredines *T. bartschi* (Lasker and Lane[2]) and *T. pedicellata* (Greenfield[3]) varies only from 1·77% to 2·17% of the dry matter and is low when compared to those of the filter-feeding lamellibranchs and the wood-boring pholads. The N values of the latter are comparable to those of the filter-feeding lamellibranchs (*Mytilus edulis, Ostrea edulis, Mya arenaria,* and *Pecten irradiatus* Vinagradov[1]) which are known to vary from 2 to 2·36%. *M. fragilis* and *M. striata* are also active filter-feeders like those forms possessing extensive ctenidia and labial palps with powerful ciliary sorting mechanisms for a mode of feeding which is predominantly planktonic. Further the animals are capable of living outside wood for a considerable length of time. They also resemble in their anatomical features the rock-boring pholads than the wood-

boring Teredines (unpublished observations). Hence the N requirements are mainly from plankton which is qualitatively richer in its nitrogen content than cellulose (Lasker and Lane[2]) from which *Teredo* derives part of its requirements. This probably implies that Martesia like other filter feeding lamellibranchs are metabolically more active than the wood-boring teredines.

I thank Dr. S. Krishnaswamy for suggesting the problem and guidance and the Forest Research Institute, Dehra Dun, for financial assistance.

Zoology Research Lab., Univ. of Madras, *February* 7, 1961. V. V. SRINIVASAN.

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A NEW SPECIES OF *CYLINDROCLADIUM* PARASITIC ON TEA ROOTS

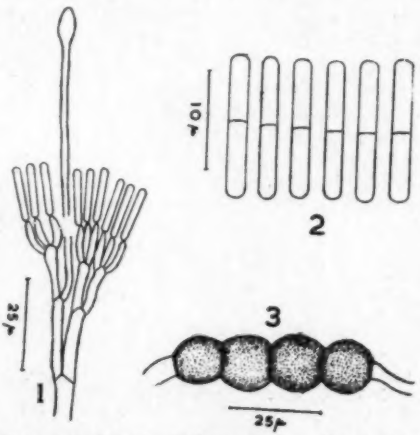
A NEW tea root disease caused by a species of *Cylindrocladium* was described from South India a few years ago[1] and it was then reported that the fungus did not correspond to any of the hitherto described species of the genus.

The species of *Cylindrocladium* are separated mainly on the basis of their conidial size, the smallest conidia being known to be produced by *C. parvum* Anderson.[2] Both on the plant material and on potato-dextrose agar, the fungus isolated by us produces conidia ($11–15 \times 1{\cdot}85\,\mu$) which are smaller than those of *C. parvum* ($15–21 \times 2{\cdot}3\,\mu$). The apex of the sterile filament is also different in shape from that of the other known species. We, therefore, place this fungus in a new species which we propose naming *Cylindrocladium camelliæ*.

Cylindrocladium camelliæ Venkataramani & Venkata Ram sp. nov.

Mycelium primo hyalinum, demum ochraceum; chlamydosporæ producuntur intercalariter subcultura. Conidiophori erecti, ramis singulis, binis vel ternis lateralibus, quorum-singuli desinunt in phialides ternas, quibus conidia insidunt; axis principalis conidiphori vulgo efformat filamentum longum desinens in bulbum ellipticum ($9{\cdot}25 \times 3{\cdot}7\,\mu$). Conidia cylindrica, recta, obtusa, semel septata, 11-15 (vulgo $13–15\,\mu$) $\times 1{\cdot}85\,\mu$ (raro $2{\cdot}0\,\mu$).

Mycelium hyaline when young and later turning ochraceous; intercalary chlamydospores produced in culture. Conidiophores erect with one, two or three lateral branches, each ending in two or three phialides on which conidia are borne singly; main axis of conidiophore mostly forming a long filament terminating in an elliptical knob ($9{\cdot}25 \times 3{\cdot}7\,\mu$). Conidia cylindrical straight, obtuse, 1-septate, 11-15 (mostly 13-15 μ) by $1{\cdot}85\,\mu$, seldom $2{\cdot}0\,\mu$ (Figs. 1–3).



FIGS. 1–3. *Cylindrocladium camelliæ*. Fig. 1. Conidiophore with the main axis forming a long filament terminating in an elliptical swelling. Fig. 2. Conidia. Fig. 3. Intercalary chlamydospores formed in culture.

Habitat—parasitic on roots of *Camellia sinensis* (L.) O. Kuntze.

A specimen of the diseased tea root material has been deposited in the herbarium of the Commonwealth Mycological Institute, Kew, under the number I.M.I. 47717 and the type culture of the fungus is being maintained in the culture collection at the UPASI Tea Experiment Station.

Since the first report of the disease,[1] we have recorded this fungus on a few occasions on roots of tea plants of different ages received from various localities in South India. An apparently identical disease has also been reported recently from the Mauritius (Orieux, 1957, personal communication).

We thank Rev. Fr. Dr. H. Santapau, for the latin description of the species.

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THE POTATO ROOT-EELWORM *HETERODERA ROSTOCHIENSIS* WOLL. IN INDIA

DURING a recent visit to Ootacamund, Madras State, several potato fields at an elevation of over 7,000 ft. above sea-level were examined. One field was lightly infested with the potato root-eelworm or golden nematode, *Heterodera rostochiensis* Woll. Spherical females in the white, golden and brown stages were observed adhering to potato roots and, when stained in cotton blue-lacto phenol (Goodey, 1957), earlier stages and males were found within them. Cysts extracted from the soil by flotation (Goodey, 1957) agreed with specimens from Great Britain in size, shape, colouration, cuticular pattern and in the arrangement of vulva and anus (Hesling, 1958, Goffart, 1960).

So far as I am aware, this is the first record of *H. rostochiensis* in India. A number of references to "potato root-eelworm" occur in the literature but these are to *Meloidogyne* spp. on potatoes. Between *Heterodera* and *Meloidogyne* there is much unnecessary confusion: the horny cysts of the former are quite distinct from the thin-walled, saccular females of the latter. Females of *Heterodera* adhere to the root systems of their hosts with only the head and neck embedded whereas those of *Meloidogyne* are usually embedded in prominent root galls.

The natural home of *H. rostochiensis* is thought to be the South American Andes where it occurs under the cool conditions afforded by high altitudes (Bell, F. H. and Alandia, B. S., 1955; Krusberg, L. R. and Hirschmann, H., 1958). The *H. rostochiensis* at Ootacamund may have been introduced in potatoes from Britain: European weeds such as chickweed, *Stellaria media* and spurry, *Spergula arvensis* also occur in the fields.

Botany Department, F. G. W. JONES.
Muslim University, Aligarh,[1]
March 9, 1961.

[*] Visiting worker from Rothamsted Experimental Station, England.

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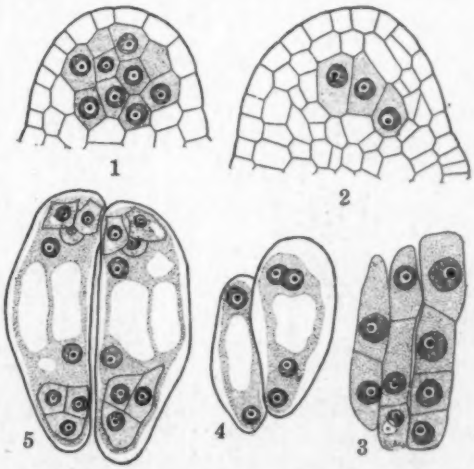
OCCURRENCE OF TWIN EMBRYO-SACS IN *CAPPARIS APHYLLA* ROTH.

WHILE studying the life-history of *Capparis aphylla* Roth., a sturdy xerophyte growing wild round about Ahmednagar, the author came across many ovules showing twin embryo-sacs. The present note describes their mode of development.

The female archesporium in *Capparis aphylla* Roth., is multicellular consisting of hypodermal and subhypodermal cells (Fig. 1) unlike in other members of the family where it is reported to be unicellular (Rao, 1936; 1938).[1,2] During development two or three megaspore mother cells develop frequently side by side (Fig. 2) to form tetrads of diverse types (Fig. 3). The selection of the megaspores is of the fixed type. The chalazal megaspore always develops into the embryo-sac of the Polygognum type (Maheshwari, 1950).[3] In many cases the two chalazal megaspores of the adjoining tetrads develop simultaneously resulting in two embryo-sacs in a single ovule (Fig. 4). Such embryo-sacs may or may not be at the same stage of development. One on the right is 4-nucleate while the other is 2-nucleate. Figure 5 shows two



FIGS. 1–5. Fig. 1. L.S. apex of nucellus showing hypodermal and subhypodermal archesporium. Fig. 2. The same as above showing three functional megaspore mother cells. Fig. 3. Megaspore tetrads. Figs. 4 and 5. Twin embryo-sacs, × 1,800.

mature embryo-sacs each one showing an egg apparatus at the micropylar end, two polars and three antipodals at the chalazal end. The structure of the egg apparatus in both the sacs is of the usual type. It is likely that these

functional eggs might develop into embryos after fertilization leading to polyembryony (Johansen, 1950).[4]

The author is grateful to Dr. L. B. Kajale, Principal, College of Science, Nagpur, for guidance and criticism. Thanks are also due to Shri M. D. Padhye for his kind help and to Principal, T. Barnabas, for his keen interest and facilities.

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SEGREGATION FOR LANKY AND NORMAL SEEDLINGS IN SORGHUM

IN the F_2 progeny of a cross between A. 6697 (male sterile sorghum from U.S.A.) and I.S. 1032 (early prodigy from Madhya Pradesh) segregation for lanky and normal seedlings was observed though the seedlings in both the parents and F_1 hybrid were normal.

In the segregating progeny, the lanky seedlings were tall and slender with long and narrow leaves. When 15 days old the average height of the lanky seedlings was 17·7 cm. (S.E. = 2·1 ; range 15 to 20 cm.) while the average height of normal seedlings was 4·7 cm. (S.E. = 0·64 ; range 4 to 6 cm.) and the leaves were short and wide. When compared with the normal seedlings the lanky seedlings were of lighter-green colour and the root system was also ill-developed. Node formation was well advanced exposing the first node. The differences between these two types of seedlings are shown in Fig. 1.

FIG. 1. *Left :* Lanky Seedling. *Right :* Normal Seedling.

The data of the lanky and normal seedlings in F_2 generation are given in Table I.

TABLE I

	Normal	Lanky
Observed ..	286	92
Expected on 3 : 1 ratio ..	283·5	94·5

$X^2 = 1·105$, P between 0·20 and 0·30.

The goodness of fit test for 3 : 1 ratio is satisfied indicating that the character for lanky producing normal seedlings. The occurrence of lanky seedlings may be attributed to a mutation in the heterozygous material. Being recessive this character has not manifested itself in the F_1 generation.

A.R.S. Lam, Guntur-2, *December* 22, 1960. C. SREERAMULU. S. RAMACHANDRARAO.

CALLUS HAIR LENGTH AND ARROW COLOUR IN CERTAIN INTER-GENERIC HYBRIDS OF *SACCHARUM*

THE length of callus hair in relation to the length of the spikelet is known to be a stable character in the species of *Saccharum* and its allied genera *Narenga porphyrocoma* (Hans. Bor) and *Sclerostachya fusca* (A. Camus). The callus hairs are about 3 times as long as the spikelet in *S. officinarum* while they are about 3½ times the length of the spikelet in *S. spontaneum*. In *Narenga* they are just as long as the spikelet while in *Sclerostachya* they are only half the length of the spikelet.

A large number of F_1 hybrids (as many as 500) of the intergeneric crosses with the species of *Saccharum*, namely *S. officinarum*, *S. robustum* and *S. spontaneum* as pistillate parents and the two allied genera, *Narenga* and *Sclerostachya*, as staminate parents were studied for the character, length of callus hair. It was found that the length of the callus hair ranged from 1¼ to 1¾ times the length of the spikelet in *Saccharum* × *Sclerostachya* hybrids and 2 to 2¼ times the length of the spikelet in *Saccharum* × *Narenga* hybrids. Thus the callus hair in the hybrids were found to be intermediate and more or less about the mean of the two parents in length.

On the basis of the chromosome number Bremer[1] considered the variety Hitam Rokan ($2n = 55$) to be a possible hybrid between *S. officinarum* ($2n = 80$) and *Narenga* ($2n = 30$). The length of the callus hair in Hitam Rokan is 1½ to 1¾ times as long as the spikelet, a feature characteristic of *Saccharum* × *Sclerostachya* hybrids studied by the authors.

Judging from this character, it would appear that the impact of *Sclerostachya fusca* rather than of *Narenga* is more probable in the evolution of Hitam Rokan.

Observations were also made on the colour of the inflorescences in the parents and their F_1 hybrids. The colour of the arrows in *S. officinarum* and *S. robustum* is purplish-white and that in *S. spontaneum* silvery-grey, whereas in *Sclerostachya* and *Narenga* the colour of the arrows is burnished copper. It was found that in all the F_1 hybrids examined the colour of the arrows was burnished copper, indicating its dominance over purplish-white and silvery-grey. Incidentally the arrow colour in Hitam Rokan is also burnished copper.

The authors are grateful to Dr. N. R. Bhat, Director, Sugarcane Breeding Institute, Coimbatore, for helpful criticism and encouragement.

Sugarcane Breeding Institute, Coimbatore-7, *December* 27, 1960.

K. S. SUBBA RAO.
P. A. KANDASAMI.
B. V. NATARAJAN.

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MODE OF INFECTION IN SAWAN SMUT (*USTILAGO PARADOXA* SYD. AND BUTLER)

THE smut of *Echinochloa frumentacea* (Sawan plants) caused by *Ustilago paradoxa* has been shown to be externally seed-borne (Kulkarni, 1922 and Sharma, 1953).

As all the ovaries in an ear are not affected, as is the case in systemic infection, it was suspected that there might be localised infection of the blossom or the developing grains also. Infection trials were, therefore, carried out as follows:

Sawan plants of three different stages of maturity: (*i*) the early blossom stage (when the ears were just emerging); (*ii*) before anthesis, and (*iii*) in the stage of grain formation were inoculated with chlamydospores of *U. paradoxa* in January 1959, in plants raised in pots. The plants after inoculation were kept in a humid chamber for 48 hours. Observations were recorded after two weeks.

Ears inoculated in the early stages of ear emergence were completely smutted, whereas those inoculated in advanced stages of maturity (when the anthers and stigma were protruding) formed typical sori transforming the ovary into a grey round sac exceeding the size of the normal grain (Fig. 1). However, ears in the grain formation stage were not infected at all.

These facts are suggestive of the localization of infection in the developing ovary and its non-systemic nature.

FIG. 1. Ear on left completely smutted. Ear on the right with typical smut sori, ovary transformed into round grey sac slightly exceeding the size of the normal grain.

Further studies are in progress to see whether this mode of infection is common in nature.

Dept. of Plant Pathology, Bihar Agricultural College, Sabour (Bhagalpur), *December* 15, 1960.

A. P. MISRA.

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CYTOGENETICS OF AN INTERSPECIFIC HYBRID IN ORYZA

CULTIVATED rice, *O. sativa* L., has been crossed with many wild species.[1] The present study deals with a hybrid (Fig. 1) between two wild

FIG. 1

$$F_1 \quad \frac{Oryza\ alta}{(4n=48)} \times \frac{Oryza\ officinalis}{(2n=24)}$$

species, *O. alta* Swallen ($2n = 48$) and *O. officinalis* Wall ($2n = 24$), using the tetraploid species as female parent. The F_1 is a triploid with $2n = 36$. The species *O. officinalis*

TABLE I

Character	*O. alta*	*O. officinalis*	F_1 *O. alta* × *O. officinallis*
Habit ..	Erect	Semi-erect	Semi-erect
Leaf size ..	Broad	Narrow	Nearer to *O. alta*
Ligule ..	Small with fringe of hairs at the apex	Small without fringe of hairs	Small with fringe of hairs
Colour of leaf sheath ..	Faint purple	Faint purple	Faint purple
Colour of nodal margins ..	Green	Purple	Green
Colour of auricle ..	Purple	Faint purple	Green
Colour of stigma ..	Green	Purple	Purple
Spikelets ..	Long and flattened	Small and flattened	Nearer to *O. alta*

is obtained from Ceylon and *O. alta*, through the courtesy of United States Department of Agriculture. The characters of the parents and the F_1 are presented in Table I. It is interesting to note that the green colour which is generally recessive to purple colour is inherited as dominant in the present cross, in the case of the colour of the nodal margins, *O. alta* having green nodal margins. Another significant observation is that, whereas the auricle is purple in *O. alta* and faintly purple in *O. officinalis* it is green in the F_1 hybrid. The F_1 is nearer to *O. alta* in plant height, leaf width, spikelet length and awn length. The pollen sterility in the hybrid is as high as 96% and the spikelets are totally sterile without any seed setting. The high gametic sterility could be due to the unbalanced chromosome complement consequent on the division of a triploid cell.

Cytological studies of the F_1 hybrid showed that $2n = 36$ in the somatic cells. Meiosis was studied with the help of the smearing technique, acetic alcohol being used as a fixative and propiono-carmine as the stain. It was observed that 12 bivalents and 12 univalents were formed regularly. At metaphase, 12 bivalents arrange to form the equatorial plate and 12 univalents are irregularly distributed at the poles. A few trivalents were also seen in a considerable number of cells, but no quadrivalents. The regular formation of 12 bivalents and 12 univalents at the metaphase of the F_1 hybrid suggests that one of the two genomes of *O. alta* is homologous with the genom of *O. officinalis*, hence if the genom of *O. officinalis* is designated as O_1O_1, that of *O. alta* could be O_1O_1, O_2O_2, suggesting that *O. alta* might have originated from *O. officinalis* through hybridization and polyploidy.

Central Rice Research Institute, Cuttack-4, *November* 3, 1960.

R. H. RICHHARIA.
D. V. SESHU.

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A CONTRIBUTION TO THE EMBRYOLOGY OF *KNOXIA CORYMBOSA* WILLD.

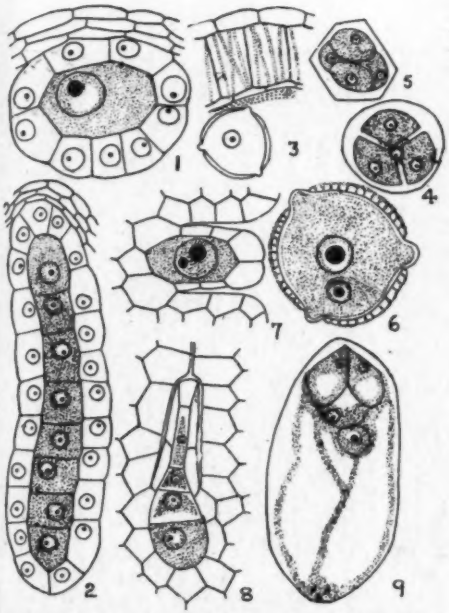
THE members of the family Rubiaceæ display features of embryological interest. Although extensive embryological investigations have been carried out in several genera of this family, the Indo-Malayan genus *Knoxia* remains uninvestigated. The material for the present investigation was collected round about Bangalore and Londa (Western Ghats).

The flowers are subsessile and are arranged in corymbose cymes. Flowers are tetramerous, bisexual and epigynous.

A single row of microspore mother cells is surrounded by the tapetum, two-wall layers and epidermis in each anther lobe (Figs. 1-2). The tapetal cells are glandular and remain uninucleate throughout, as in *Oldenlandia corymbosa* (Farooq, 1958). At maturity the endothecium exhibits the usual fibrous thickenings (Fig. 3). The microspore mother cells by meiotic divisions give rise to microspores which are usually tetrahedral but occasionally decussate in arrangement (Figs 4 and 5). The meiotic divisions of microspore mother cells in the same anther are often not synchronous. The pollen grains are tri-porate with a thick smooth exine and a thin intine. The mature pollen grains are two-celled (Fig. 6).

Two pendulous ovules arise from the tip of the central column within a bicarpellary syncarpous ovary and grow downwards towards the base of the ovarian cavity. Further growth on one side causes the ovules to simulate circinotropous condition. The ovules are tenuinucellate with a single massive integument. The nucellar epidermis is made up of five to six cells and conforms to the Phyllis type in the reduction series of the nucellus (Fagerlind, 1937). A single hypodermal archesporial cell directly functions as the megaspore mother cell (Fig. 7) as in *Dentella repens* (Raghavan, T. S. and Rangaswamy, K. 1941). The megaspore mother cell by meiotic divisions gives rise to linear

tetrad of megaspores (Fig. 8). The megaspores do not display the peculiar haustorial behaviour as in some members of the Rubiaceæ (Fagerlind, 1937). The nucleus of the functioning chalazal megaspore by three successive divisions gives rise to an eight nucleate embryo-sac of the Polygonum type. The synergids neither exhibit filiform apparatus nor are they hooked. In the fully organised embryo-sac the secondary nucleus remains close to the egg (Fig. 9). The antipodals do not display any abnormal behaviour as reported in some members of the Rubiaceæ (Fagerlind, 1936 *a*, 1936 *b* and 1937).



FIGS. 1–9. Fig. 1. T.S. of young anther lobe showing a single microspore mother cell surrounded by tapetum, middle layer endothecium and epidermis, ×1000. Fig. 2. L.S. of young anther lobe showing a single row of microspore mother cells, ×500. Fig. 3. Portion of anther wall showing fibrillar endothecium, ×500. Figs. 4 and 5. Tetrahedral and decussate arrangement of microspores, ×1,500. Fig. 6. Two-celled pollen grains, ×1,500. Fig. 7. L. S. of ovule showing hypodermal archesporial cell, ×1,000. Fig. 8. Linear tetrad of megaspores, ×1,000. Fig. 9. Mature embryo sac, × 500.

Our thanks are due to Prof. S. Shamanna for guidance, to Mr. V. S. Panth for kind help and to Rev. Fr. E. D'Souza, S.J., for encouragement.

Dept. of Botany,
St. Joseph's College,
Bangalore, *April* 22, 1961.

G. SHIVARAMIAH.
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SOME OBSERVATIONS ON A ROOT-PARASITE—*AEGINETIA INDICA* LINN.

Aeginetia indica Linn., a root-parasite, is a purplish plant with small rhizomes bearing numerous, short, branched, coral-like roots. The flowers are large, solitary on the top of a naked scape. This root-parasite is reported to be found in a number of forest areas in and outside the Bombay Presidency. In all the standard floras the plant is reported without a definite mention of the host plants. Both Cooke (1903) and Hooker (1875) are silent on this point. Trimen (1895) in his flora of Ceylon mentions the plant as a parasite on various roots. According to Gamble (1916-34) the plant is apparently parasitizing the roots of many different plants, the names of which are not mentioned. Santapau (1955) in his contributions to the Botany of Dang Forests, Bombay State, remarks that it was not possible to trace the host plant. Even in the more recent publications on the flora of this region, a mention of the host plants is not made. As far as we are aware, there does exist a lacuna in our knowledge of the host-parasite relations in this species.

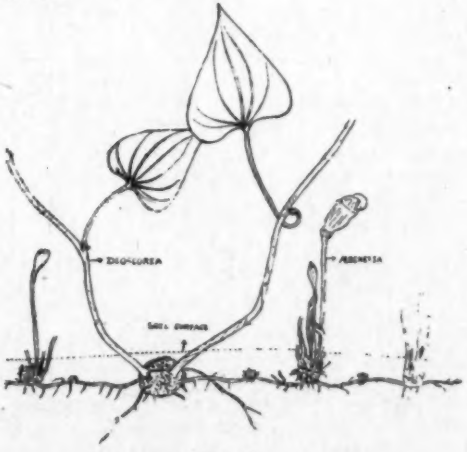

FIG. 1

This lacuna in the knowledge and the vagueness of the remarks made by some of the

previous workers prompted us to undertake a study of the nature of parasitism in this species, which, though not very common, is locally abundant on the Ratanmahal Hills (Banvra—450 meters above M.S.L., Panchmahal District, Gujarat State) by the side of a stream and on humus soils. Up till now even after great efforts, we have been able to trace only one host plant, *viz.*, *Dioscorea* sp. and the other plants growing in the vicinity are apparently not parasitized. This very fact leads us to a conclusion that cosmopolitan nature of parasitism as reported by Trimen and Gamble may not be correct. In this connection we would welcome any other information gathered by workers in the country. We believe that *Dioscorea* sp. as a host plant for *Aeginetia indica* Linn. is reported for the first time.

As already observed by Rawat and Ambasht (1958) in the case of *Orobanche*, the roots of *Dioscorea* which were heavily parasitized also showed enormous length ranging from 122 to 183 cm., whereas the unaffected roots were comparatively very short and measured about 30 to 45 cm. It is rather premature to account for the anomalies in the growth of affected and unaffected roots, but it is hoped that from further studies in this direction a clearer picture of host-parasite relationship in this species, will emerge.

Department of Botany, M.S. University of Baroda, Baroda, *January* 27, 1961.

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S. D. Sabnis.

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BEAN FLY, A SERIOUS PEST OF FRENCH BEANS

During 1952-53 it was found that French Bean seedlings (*Phaseolus vulgaris*) were wilting and the crop could not be grown successfully at Himayatsagar Farm, Hyderabad. An examination of the affected plants revealed the presence of small whitish maggots and yellowish puparia embedded in the stem. The insect causing the damage was identified as *Melanagromyza phaseoli* Coq. (Agromyzinæ, Agromyzidæ—Diptera). This fly is known to cause considerable damage to cowpea in India. However, its attack on French Beans was not noted so far, from the former Hyderabad State, and for the first time this pest has been reported. Recently this insect has been found doing considerable damage to French Bean crop in the Delhi Territory also.

The general symptoms of the attack of *M. phaseoli* are the drooping and withering of leaves and finally wilting of the plant. In young plants the attack is characterized by the drooping of the first two leaves. The stems burst at or just above the ground level, where maggots and puparia concentrate and large calloused areas deve'op (Fig. 1). In older plants the

FIG. 1. Bean Fly infestation causing calloused and swollen areas on the French Bean stem at the ground level.

joints of branches are attacked and they droop, finally dying or breaking off during picking and other operations or strong winds.

Morgan (1938) and Caldwell (1939) have worked out the life-history of the fly in Austraalia.

Preliminary observations carried out at Himayatsagar Farm, showed that the eggs were laid on the leaves as soon as they appeared above ground. In the seedlings the larvæ mined the leaves for 1-2 days and then tunnelled down the leaf stalks to the base of stems, feeding at ground

level until they were mature. The tunnels were below the epidermal layer, which appeared as white streaks. The stem where maggots or puparia concentrated looked like a gall and the epidermis after drying became loose and could easily be removed, exposing the maggots or the puparia (Fig. 2). However, in older plants the

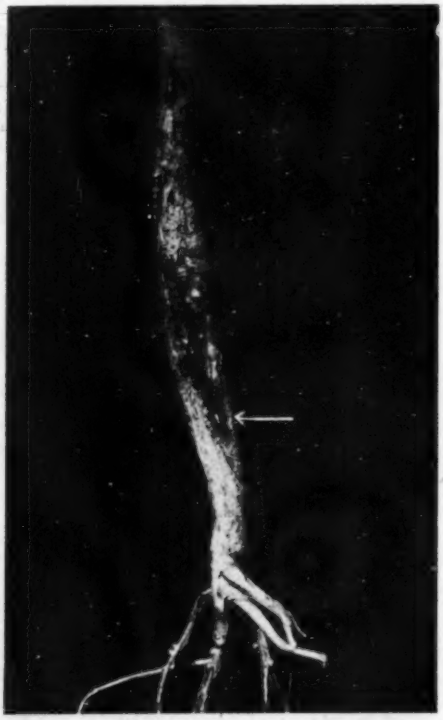

FIG. 2. Severely infested stem of French Bean; arrow indicating the position of puparia of *Melanagromyza phaseoli*.

maggots could be found in the joints of branches and the leaf stalks, in which case only the attacked portion withered. The tunnelled branches easily broke off at the slightest touch, and the unaffected portions of the plant continued to flower and set fruits. The attack increased with the warmer weather.

Rarely single maggot was found in a plant. The maximum number of maggots obtained per plant was 8 and on an average 4-6 maggots were found in a stem. However, the number of maggots attacking the branches and the joints at a time was less. In cases of mild attack, plants put forth adventitious roots at or above the point of attack at the ground level and survived to yield a crop.

A chalcid parasite was reared out.

Preliminary trials at Himayatsagar Farm were conducted with the following insecticides applied as sprays at weekly intervals;

(i) Fish oil Rosin Soap at the rate of one ounce per gallon; (ii) 0·03% Nicotione Sulphate; (iii) 0·16% D.D.T.; (iv) 0·03% Folidol and (v) 0·02% Lindane.

The results indicated that Nicotine Sulphate and D.D.T. were effective in reducing the infestation. Further trials are being carried out to evolve a suitable control schedule.

Extension Directorate, D. B. REDDY.
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THE RECORD OF PARASITIC NEMATODES OF SUGARCANE IN BIHAR

PARASITIC nematodes have been reported from abroad to cause injury to sugarcane crop. In India, the occurrence of parasitic nematodes in sugarcane appears to have been first reported by Srinivasan (1958), who found *Radopholus similis* (Cobb.), Thorne, associated with Chlorosis disease. The other species recorded from sugarcane are: *Meloidogyne* sp. (David, 1959), *Tylenchorhynchus* sp. and *M. javanica* (Treub.) Chitwood (Rangaswamy *et al.*, 1960) and *Helicotylenchus erythrinæ* (David and Thiruvengadam, 1960). The symptoms of attack of these species were stunting and chlorosis of infested plants.

The authors came across similar symptoms as reported by other workers in a sugarcane field at Pusa in March 1960. A detailed examination of the infested material revealed the presence of a few nematodes which are described below.

The material consisted of four species of parasitic nematodes belonging to the genera *Ditylenchus, Aphelenchoides, Hoplolaimus* and *Meloidogyne*. The specific determination of the first three genera could not be done due to the lack of adult stage in the collection, while the fourth was identified as *Meloidogyne javanica*. The species of *Hoplolaimus* has been considered as new species.

A few free living soil nematodes belonging to the genera *Disploscapter, Cephalobus, Dorylaimus* and *Cheiloplacus* were also found associated with the parasitic stock. Examples of *Aphelenchus avenæ*, which is considered as a

secondary parasite in necrotic situations, were also present in the collection.

The measurements of the specimens of *Hoplolaimus*, which has been considered to be a new species, are given as under (Fig. 1).

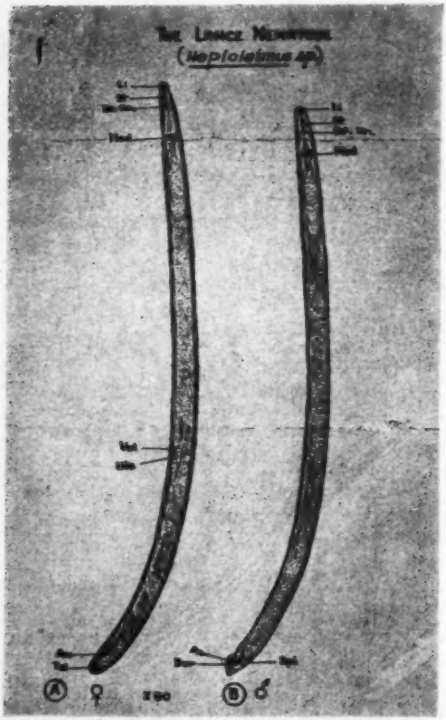

FIG. 1. *Li*, Lip; *St*, Stylet; *Ba*, *Kn*, Basal Knob; *Med*, Medium Bulb of Oesophagus; *Vul*, Vulva; *Ute*, Uterus; *An*, Anus; *Tal*, Tail; *Bur*, Buersa; *Spi*, Spicule.

♂–length 1·06–1·14 mm.; width 32–36 μ; œsophagus 88–90 μ; tail 26–28 μ and spear 36 μ.

♀–length 1·18–1·33 mm.; width 36–40 μ; œsophagus 92–94 μ; spear 36–40 μ and the distance of vulva from anterior end 650–700 μ.

So far, the parasitic nematodes in sugarcane have mostly been reported from South India but the observations by the authors show that these pests occur quite commonly in North Bihar. Recently, a new chlorotic disease has appeared in Bihar and Uttar Pradesh and a detailed study of these nematodes might help in determining the cause of this disease.

The authors are grateful to Rev. Father R. W. Timm, Namatologist, Notre Dame College, Dacca, for kindly identifying the specimen reported in this paper. Thanks are also due to Dr. A. Ganguly, Sugarcane Pathologist, Pusa, for helping in these studies.

Sugarcane Research Inst., Pusa, Bihar, *January* 19, 1961.

Z. A. SIDDIQUI.
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CHROMOSOME NUMBERS IN THE GENUS *CURCUMA* LINN.

THE cytology of six species and several varieties of *Curcuma* has been investigated in the course of the present study. Cytological studies were made from acetocarmine smears of root-tips and anthers fixed in Carnnoy's fluid. Root-tips were anthers fixed in Carnnoy's fluid. Root tips were subjected to short periods of cold treatment prior to fixation.

The chromosome numbers determined in the present study and those reported previously in this genus are listed in Table I.

The chromosomes of all the species of *Curcuma* are small, between 0·6 μ and 1·7 μ in length. The basic number of the genus is 21. Evidently this is too high to be the primary one. It is possibly a secondary balance derived by amphidiploidy from a combination of 9 and 12 found in many genera of the Zingiberaceæ. Aneuploids, reported by others, were not observed among the triploid types of the present study. The two tetraploids of *C. aromatica* studied were aneuploids with 86 (84 + 2) chromosomes. $2n = 86$ is the highest number observed in this genus and is being reported for the first time.

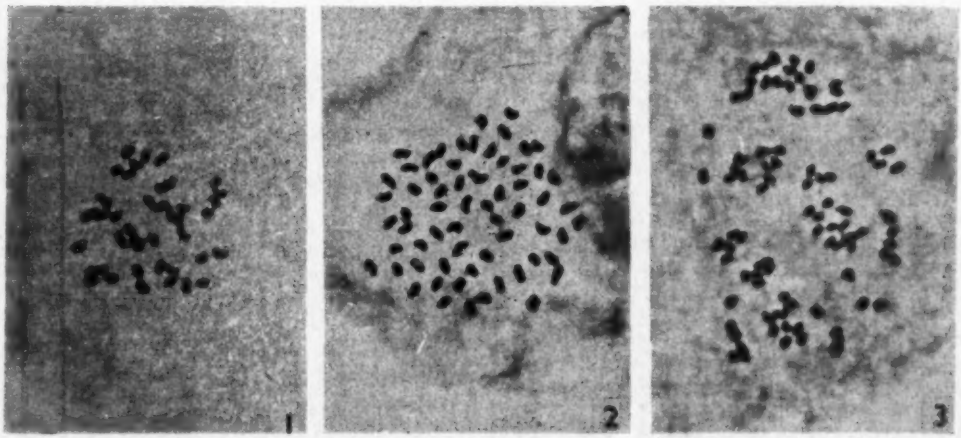
Meioses in *C. decipiens* ($2n = 42$) and *C. longa* ($2n = 63$) have been studied in detail. In the former it is regular forming only bivalents at metaphase I. Meiosis in *C. longa* showed that it is an autotriploid, with a high percentage of trivalent associations, in spite of the small size of the chromosomes. The sterility of *C. longa* is due to its autotriploid constitution.

The presence of forms showing characters intermediate between *C. longa* and *C. aromatica* (both having $2n = 63$) shows that natural

TABLE I

Chromosome numbers in the genus Curcuma

Name	Source	Chromosome numbers ($2n$)	
		Present study	Previous observations
Curcuma decipiens Dalz.	Kerala	42	..
C. neilgherrensis Wight.	,,	42	..
C. amada Roxb.	,,	42	42 (Chakravorti[1])
			42 (Sharma and Bhattacharyya[4])
C. zeodaria Rosc.	,,	63	64 (Venkatasubban[6])
			63, 64 (Chakravorti[1])
C. aromatica Salisb.	,,	63	42 (Raghavan and Venkatasubban[2])
"G. L. Puram type"	Turmeric Research Station, Pedapalam, Andhra	63	..
"Kasturi amalapuram"	,,	86	..
"Polavaram"	,,	86	..
C. longa Linn.	Kerala	63	64 (Sugiura[5]),
			62 (Raghavan and Venkatasubban[2]),
			32 (Sato[3]),
			62, 63, 64 (Chakravorti[1])
"Duggirala type"	Pedapalam	63	..
"Kovvur Desavali"	,,	63	..
"Tekurpeta"	,,	63	..
"Types intermediate between *C. longa* and *C. aromatica*"			
"G.L. Puram 2"		63	..
"Kasturi Duggirala"	,,	63	..
'Nallakatla pasupu"	,,	63	..
C. angustifolia Roxb.	..	..	42 (Chakravorti[1])
			42 (Sharma and Bhattacharyya[4]),
C. petiolata Roxb.	..	..	64 (Venkatasubban[6])



FIGS. 1–3. Somatic chromosomes of *Curcuma* species. Fig. 1. *Curcuma amada*, $2n = 42$. Fig. 2. *Curcuma longa*, $2n = 63$. Fig. 3. *Curcuma aromatica*, $2n = 86$. (All figures, × 1,500.)

crossing has occurred between these two species, or that one of these is evolved from the other by successive mutational steps, represented by these intermediate types. The herbaceous perennial habit of these plants, their vegetative mode of propagation and the small size of the chromosomes favour the perpetuation of polyploid types in this genus.

This work was carried out under a scheme of research on Miscellaneous Tuber Crops and Related Plants financed by the Indian Council of Agricultural Research. My thanks are due to Prof. A. Abraham, University of Kerala, for guidance, to Mr. S. Sangameswara Sarma, Research Officer, Turmeric Research Station, Pedapalam, Andhra, for supplying tuber materials of some of the types included in this study and to the University of Kerala for research facilities.

Department of Botany, K. RAMACHANDRAN.
University College,
Trivandrum, *January* 9, 1961.

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REACTION TO SHADOW IN *DASYCHONE CINGULATA* GRUBE. (POLYCHAETA)

AMONG the sedantary animals, many of the sabellids and serpulids have been found to respond to photic stimulation (*Sabella spallanzanii*, Loeb, 1903, 1918, Fox, 1938; *Hydroides dianthus*, Bohn, 1902; *Serpula vermicularis*, Hargitt, 1906; *Bispira volutacornis*, Hess, 1914; *Branchiomma vesiculosum*, Nicol,[1] 1950). In the common sabellid, *Dasychone cingulata*, Grube of the Madras harbour, Tampi[2] (1949) while describing the eyes made a reference to the shadow reaction in them. However no detailed analysis of this behaviour has been carried out so far. *Dasychone cingulata* Grube when kept in light shows two types of movements: (i) Complete retraction of the worm into its tube and (ii) movement of branchial crown or branchial filaments. The two types of movements are intermingled and consist of bursts of activity alternating with periods of rest. Of these, the withdrawal of the worm into its tube is the more prominent of the two. The spontaneous movements are greater at higher intensities than in the lower intensities of light.

Although *Dasychone* responds to a decrease in intensity in a spectacular way, it is also found to respond to a sudden increase in intensity. But the worm gets rapidly adapted when the stimulii at short intervals continue and it ceases to respond.

The data obtained from thirty-seven animals showing response to shadow at intensities, ranging from 5 to 95 lux, point out that there is a tendency for the animals to respond more in the higher intensities of light than in the lower intensities (*e.g.*, 48·7% at 5 lux as against 81·5% at 95 lux). Similarly, dark adapted forms are more sensitive than the light adapted forms. Again, adaptation to a certain intensity of illumination for a greater period of time results in a greater sensitivity to a passing shadow.

The intensity of illumination does not play a part in the emergence of the worms from their tubes, since 99·3% emerged, in one hour, at intensities ranging from 5 to 95 lux. The time taken for the emergence of the worms from their tubes, after contraction, varied between 1 min. 21·42 sec. at 5 lux and 52·8 sec. at 95 lux and the mean time of emergence was 1 min. 0·8 sec. Similarly, with the increase in intensity of illumination, there is also an increase in the number of times the animals contract and re-emerge.

The range of spectral sensitivity is wide in *Dasychone cingulata* Grube as shown by its responses to shadow in different coloured lights —especially more prominent in blue and yellow. Though the evidence is not conclusive, the photoreceptors of the animal, do seem to play a part in the responses of *Dasychone cingulata* Grube to photic stimulation.

The details of this work will be published elsewhere.

I am much indebted to Dr. S. Krishnaswamy, Reader, Zoology Research Laboratory, for suggesting the problem, for guidance and encouragement. I am also thankful to Dr. C. P. Gnanamuthu, Director, for his interest in this work.

Zoology Res. Lab., R. THEODORE SRINIVASAGAM.
University of Madras,
Madras-5, *February* 6, 1961.

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REVIEWS

Text Books in Mathematics. By Horace Lamb. (Cambridge University Press, London, N.W. 1), *Dynamics*: Pp. xi + 357. Price 18 *sh.* 6 *d.*, *Statics*: Pp. xii + 357. Price 18 *sh.* 6 *d.*

Lamb's books on Dynamics and Statics are well known to students of mathematics and have been in popular demand ever since their publication nearly fifty years ago. The present volumes are the ninth reprints of the revised editions of the 1920's. These books are not classics like the author's 'Hydrodynamics' but have served as useful text-books to graduate and honours students in mathematics. That reprints of the books were found to be desirable as well as profitable to the publishers, even in this decade, is a clear indication of both the popularity of the book as well as the sad plight of the syllabus in universities, that refuses to introduce newer developments or a more modern presentation. The paper cover editions issued at cheap price (by present standard) will be welcomed by students and teachers of mathematics.

V.

The Correspondence of Sir Isaac Newton. Edited by H. W. Turnbull, F.R.S. Vol. I (1661-75): Pp. xxxvii + 467; Vol. II (1676-87): Pp. xii + 551. Price 147 *sh.* each. (Cambridge University Press, 200, Euston Road, London, N.W. 1), 1959/60.

A comprehensive edition of Newton's scientific correspondence is clearly most desirable, and no scientific body is more competent to undertake this task than the Royal Society of London. The magnitude of the work and the difficulties involved in the undertaking can easily be guessed from the fact that although the Royal Society has been engaged in this task for the past nearly three decades it was only in 1959 that the first volume could be brought out. The second volume has been published in 1960, and it is expected that the remaining volumes of the seven that will constitute the complete series will be published in the course of the next two years. Prof. Turnbull who was invited by the Council of the Royal Society in 1947 to undertake the editorship of the series has done an excellent job and placed the scientific world in general, and the scholars of the history of science in particular, under a deep debt of gratitude.

The volumes are to comprise all scientific letters of Newton and letters written to him and such other letters and documents as are necessary to clarify the correspondence. They have been arranged in chronological order, and wherever the texts are in Latin, the translations in English are also given.

In the first volume Prof. Andrade has written a scholarly introduction. This volume contains 156 letters covering the period 1661-75. Most of these letters, as also those in the second volume, were addressed to Oldenburg who as Secretary of the Royal Society and as editor of the *Philosophical Transactions* acted as medium for the scientific correspondence between Newton and other men of science. The first volume includes Newton's description of his telescope, the discovery of the composite nature of sunlight and the famous *experimentum crucis*, his letters dealing with Hooke's criticism of his views on refraction and colours, letters on fluxions and quadratures, and some on celestial mechanics.

The second volume covers the period 1676-87, and contains 162 letters out of which as many as 66 have not been previously published. A good many letters in this volume are concerned with the long drawn out correspondence between Lucas and Newton on Newton's new theory of light and colours. Another important content of this volume is the correspondence on the infinite series between Newton and Leibniz and Tschirnhaus. It includes the two letters: (i) *Epistola Prior*, and (ii) *Epistola Posterior*, known as "a veritable Newtonian treasury", and of which two pages of the original in Latin in Newton's handwriting appear as photoplates.

There is an interesting letter (232) which contains Newton's subtle reply to one Maddock (probably an unrecognized precursor of Sir Willian Herschel who was the first to investigate the invisible part of the spectrum), to the latter's thesis on "rays of darkness" and the query whether these rays will be refracted according to the law which governs rays of light. There are also letters relating to the great comet of 1680, letters on Boyle's discoveries, and even some on cider apples and methods of improving their quality.

These letters, besides their great scientific value, throw light on Newton's character and

on his relations with the contemporary men of science. There is no doubt that these volumes that have been produced in excellent print, paper and binding, should be in the possession of all scientific libraries and institutions.

S. P.

Homology Theory—An Introduction to Algebraic Topology. By P. J. Hilton and S. Wylie. (Cambridge University Press, London, N.W. 1), 1960. Price 75 *sh.*

In the general introduction to this rather voluminous treatise the authors confess with admirable candour that some of their friends have told them "that this is not the time to write a book on Homology Theory, at any rate not a book of this kind". The reviewer shares to a considerable extent this opinion, particularly in so far as "a book of this kind" is concerned. The reason is that Algebraic Topology is one of the domains which, at present, are continually and rapidly expanding. It follows that any text whose ambition is not restricted to a treatment as simple, concise and selective as possible may hardly deserve to be called an Introduction. The reviewer feels that the mimeographed notes of H. Cartan (Harward, 1949) as well as some of the seminars mentioned in the bibliography constitute for the time being the best introduction possible, not going beyond a reasonable, minimum of notions and propositions around which a research stndent may easily organize his knowledge of the more advanced portions.

The first part of the book under review is devoted to the theories of homology, cohomology in the particular case of simplicial complexes. Infinite complexes are not excluded. Such theories call for a certain amount of what is now called Homological Algebra and the authors provide the reader with a systematic account of it in which, however, digressions and refinements might have been avoided: they will prove a hurdle to students not previously acquainted with Algebraic Topology, a category of persons for whom this book has been primarily written. The reviewer is also of opinion that the terminology and the notations of the authors are rather unfortunate. There is nowadays an almost universally accepted convention about saying cohomology and not contrahomology, about writing Hom(A, B), Tor(A, B) and Ext(A, B) instead of $A \uparrow B$, $A * B$, $A + B$. Students obliged to read extensively books and memoirs will find it unpleasant to have to remember a multiplicity of terms and symbols.

The second part of the book deals with a much more advanced kind of Algebraic Topology. It is concerned with the theories of Singular Homology and of the Čech cohomology. It deals also with homotopy groups and the theory of obstruction cocycles. The chapters devoted to these theories are among the most interesting of the text. A last chapter treats of Spectral Homology and Spectral Cohomology.

It is surprizing that the authors have not found it convenient to give a better and more complete account of the theory of differential forms. It has played, and is still playing, a very important part in Algebraic Topology along with its generalisation by Alexander. The de Rham theorem and the proof of it given by H. Cartan in his Seminar of 1948-49 should certainly occupy a place of honour in an Introduction.

If this Introduction is not, in the opinion of the reviewer, quite suited to the needs of a novice in the subject, it should however prove useful to research students having already studied the fundamentals of it. This because neither H. Cartan's notes, nor the Seminars by him and his collaborators, contain any exercises. Even the Foundations of Algebraic Topology by S. Eilenberg and N. Steenrod do not propose so many problems as the book under review (in particular they do not deal with homotopy). The problems found in great abundance in this Introduction, along with a certain number of developments which tend to make the text hard reading, will undoubtedly be very much appreciated by all those who want to become intimately acquainted with Algebraic Topology and to acquire a sufficient grasp of it to contribute to its further growth.

The reviewer was astonished not to find in the bibliography any mention of the pioneer and fundamental work of J. Leray, one to whom modern Algebraic Topology owes so much.

C. RACINE.

Infra-Red Methods, Principles and Applications. By G. K. T. Conn and D. G. Avery. (Academic Press, Inc., New York and London), 1960. Pp. viii + 203. Price $ 6.80.

In spite of many books on the subject of the infra-red, the reviewer believes the present publication satisfies a real need felt by all those interested in a simple yet complete survey of practical techniques of the field. A selection of some of the main chapter headings will by itself serve to substantiate this statement: Sources of Radiation, Optical Materials, Detec-

tors, Amplifiers, Dispersive Systems, Instruments for Gas Analysis and Plant Control, Radiation Pyrometry. S. P.

Addison-Wesley Series in Physics—Reading (Massachusetts, U.S.A.)

Introduction to Mechanics, Matter and Waves. By U. Ingard and W. L. Kraushaar. 1960. Pp. xv + 672. Price $ 7.00.

The book *Introduction to Mechanics, Matter and Waves* has been written as a text-book for the first year of a two-year course in general physics in American Universities. The plan of the book has been arranged to fit in with allied courses in mathematics which the student is expected to be studying concurrently. Thus fundamental ideas about motion, collisions, inertial mass and momentum are dealt with first, and the concept of force, as the rate of momentum transfer from one body to another during an interaction, is taken up later, by which time the student would have learnt enough in the calculus course to follow differentiation. The conservation laws of mass, momentum, energy and angular momentum have been dealt with in the clearest way possible. The five chapters on Examples of Forces and Motion are particularly instructive and deal with such diverse topics as square-well oscillator, two body oscillator, molecular vibrations, orbits in gravitational force fields, Rutherford scattering, precession gyroscope, etc. The chapters on heat and thermodynamics, mechanics of fluids, and wave motion have been dealt with in an easily understandable manner. The book throughout appeals to the deductive reasoning and intelligence of the student.

Foundations of Electromagnetic Theory. By J. R. Reitz and F. J. Milford, 1960. Pp. xi + 387. Price $ 6.50.

The book is fundamentally of a mathematical nature and is intended for those who have a well-grounded knowledge of classical electricity and magnetism together with a good background in mathematics. The treatment is by vector methods. With the rapid progress that atomic physics has reached and the new concepts in the physics of the solid state, advanced students of electricity and magnetism will naturally approach the subject from the basic atomic constitution of matter and the electric and magnetic properties associated with them. This aspect has been kept in the forefront by the authors in writing this text-book and developing the various topics in a connected manner. The chapters on microscopic theory of dielectrics, and of magnetic properties of matter and the one on the physics of plasmas are particularly interesting from this point of view.

This book can be recommended as a good supplementary text-book to the Graduate and Honours students of Indian universities.

Principles of Electricity and Magnetism. By E. M. Pugh and E. W. Pugh, 1960. Pp. xi + 430. Price $ 6.50.

This is an advanced text-book on electricity and magnetism suitable for an Honours course in Physics. A good background knowledge of mathematics including vector analysis is expected of the student who will be using this text-book. However, a brief but self-contained exposition of basic vector analysis forms a separate chapter. Similarly a chapter is devoted to the fundamental principles of mathematics required for the general solution of electrostatic problems. The first six chapters of the book are devoted to static electricity and steady state current phenomena. The remaining five chapters are devoted to electromagnetic induction, magnetic properties of materials, alternating currents, and electromagnetic radiation. Each chapter ends with a number of problems, many of which are more in the nature of supplement to the textual matter than mere applications of it.

An Introduction to Electronic Theory of Organic Compounds. By H. L. Heys. (George G. Harrap and Co., Ltd., London ; Oxford University Press, Madras-2), 1960. Pp. 236. Price 16 *sh.*

As the title indicates, this book is an introduction to theoretical organic chemistry. It is intended to act as a bridge between the study of theoretical organic chemistry at the elementary and advanced levels. Mr. Heys has tried to present all the highlights of modern concepts and theories in simple language. Unfortunately, he has omitted several very important subjects. A few such bad omissions are, Hammett equation, acidity functions, recent work on steric effects (particularly the contribution by Brown and co-workers), neighbouring group participation (the contribution by Winstein and co-workers), internal rotation, conformation analysis, etc. In some places, the literature references cited are not representative. In trying to use simple language, inaccurate statements have been made occasionally. The author has mentioned diffraction and spectroscopic methods as structural tools. It would have been much better if these

structural methods had been discussed in slightly greater detail. Ultra-violet and visible spectroscopy has not been given any importance in the book. It is the opinion of the reviewer that any course in theoretical organic chemistry should necessarily include a sufficiently detailed discussion of the structural applications of infra-red and electron spectroscopy.

The book may still be used as an elementary introduction to theoretical organic chemistry.

C. N. R. RAO.

Handbook of Textile Testing and Quality Control. By Elliot B. Grover and D. S. Hamby. (Textile Book Publishers, Inc., a Division of Interscience Publishers, Inc.), 1960. Pp. 614. Price $ 17.50.

The *Handbook of Textile Testing and Quality Control* by E. B. Grover and D. S. Hamby fills a void in the existing Textile Literature. It gives authoritative procedures of testing methods for determining the various attributes of the fibre and yarn, especially in regard to cotton and synthetic fibres and the yarns spun on the cotton system.

The lay-out of the book follows a logical pattern. The first chapter deals with the concept of quality control. It is followed by eight chapters on statistical methods which are essential for understanding the correct significance of quality control. The other chapters mostly deal with the details of the various testing methods for determining the properties of the fibres, yarn and fabric.

The description of each test procedure also follows a set pattern. After dealing with the manner of selecting the sample for test and handling the material, it gives the mode of operation of the instrument or machine for determining the particular property by avoiding or minimising sources of error, the method of calculation of the result and its interpretation. The testing procedures are in conformity with the accepted standards and are laid out in clear language. Not only does this help a novice to understand and follow the correct procedure for testing, but also it aids the experienced workers to follow uniform practices, so that reproducible results could be obtained, as far as possible.

Having dealt with the various fibre properties and the yarn strength, the effect of staple length on the yarn strength has been considered. It would have been more complete, if the relative importance of other properties had also been considered giving different regression equations for different groups of cottons.

Excellent as the book is, it appears to be confined, more or less, to the procedures followed in U.S.A. One cannot help feeling that the value of the book would have been further enhanced, if the authors' horizon had extended to the other parts of the world.

R. L. N. IYENGAR.

Toxicology—Mechanisms and Analytical Methods, Vol. I. Edited by C. P. Stewart and A Stolman. (Academic Press, New York and London; India: Asia Publishing House, Bombay-1), 1960. Pp. 774. Price $ 22.

The detection of poison in the body fluids, stomach wash and excreta during life and in tissues of the body after death is of paramount importance if poisoning has to be proved before a Court of Law. The incidence of poisoning both acute and chronic is constantly increasing as new chemicals are placed on the market and are used in homes and industry. The use of modern pesticides like Parathion, Endrine, etc., have resulted in cases of accidental poisoning. There are also many poisonous plants which are easily available in rural areas. In addition, there are many drugs which may produce side reactions of varying severity. There are, therefore, hundreds of substances to which one may be exposed giving rise to poisoning.

The isolation, characterisation, detection and estimation of such a wide range of substances from body fluids and tissues calls for great ingenuity on the part of the analyst. The classical methods hitherto followed in Forensic Science Laboratories have been found to be inadequate. Modern instrumental methods of analysis have necessarily to be applied. It is frequently necessary to isolate the poisonous principle in a pure form before instrumental methods can be employed. Many advances made in the field of chemical analysis are widely scattered in books and journals. The book under review has placed in the hands of the analyst wealth of information on all the modern methods in one volume.

The book which consists of 18 chapters is the work of 15 collaborators. Each chapter is written by a recognised authority in the special field of knowledge which he reviews and evaluates. At the end of each chapter there is a good bibliography.

In Part I, consisting of 6 chapters, the editing authors have dealt with the absorption, distribution and excretion of poisons and their metabolites. In Part II, the modern analytical techniques which are available for the Toxicologists along with the discussion of the principles on which they are based have been

given. Almost all modern methods of analysis such as Chromatography, both column and paper, use of Ion-Exchange resins, paper electrophoresis, emission and absorption spectra, Ultraviolet Spectrophotomery, Infra-red Spectroscopy, X-ray diffraction analysis, Polarography, Optical Crystallographic methods, Countercurrent distribution, Micro-diffusion analysis and Dye methods have been described with sufficient examples.

The book is an essential acquisition not only for all Forensic Science Laboratories where criminal human and cattle poisoning is investigated, but also to clinical chemists and biochemists, who may be required to assist the Pharmacologists in the evaluation of new drugs which may be potential poisons.

N. K. IYENGAR.

Petrology for Students. By Alfred Harker. Revised by C. E. Tilley, S. R. Nockolds and M. Black. (Cambridge University Press, London, N.W. 1), 1960. Pp. 283. Price 15 *sh.*

This book by Alfred Harker was first published by the Cambridge University Press, in 1895 and since then it has been a popular guide to all students of Microscopic Petrology. Its popularity amongst the students is indicated by the number of reprints it has gone through. This Edition has been fully revised by the three authors.

The book has been divided into five chapters. The first three chapters have been devoted to igneous rocks. The fourth chapter to sedimentary rocks and the last chapter to Metamorphic rocks. Practically all the groups of rocks have been described. A large number of Microphotographs to illustrate type rocks from different localities have been incorporated.

In the introductory chapter of this book, important optical characters have been described to enable the students to pick up the technique of rock identification easily.

The book is priced at 15 *sh.* and this standard publication on microscopic petrology is indispensable for all students preparing for the University Examination. M. R. S.

Advances in Documentation and Library Science (Vol. III, Part 1)—Information Retrieval and Machine Translation. Edited by J. H. Shera and Allen Kent. (Interscience Publishers Inc., New York), 1960. Pp. xv + 686. Price $ 23.00.

This is the first of the two parts of the papers and the proceedings of the International Conference for Standards on a Common Language for Machine Searching and Translation. It was sponsored by the Western Reserve University and the Rand Development Corporation and held in Cleveland (Ohio, U.S.A.) from 6 to 12 September 1959. The volume includes 21 papers. Thirteen of them are from U.S.A., two from India, two from U.S.S.R., and one each from France, Germany, Holland, and Japan.

The first paper by Kent occupies a third of the volume. It gives a review of the projects in different countries on machinery for search and translation. This includes no project from India.

One of India's papers is on *Classifying, indexing, coding* by S. R. Ranganathan. It traces the different stages in the development of facet analysis in association with Colon Classification. It lays bare the progressive overcoming of rigidity in the idea, verbal, and notational planes until the postulational approach is reached. It sets forth the problems for the designers of search-machinery as viewed by a classificationist. The second paper from India is on *Faceted classification as an approach to machine coding* by S. Parthasarathy, Head of the Insdoc. It tabulates the difference in the quality of the notation needed for classification and machine-coding respectively. It makes out that the best result could be got by the successive use of subject heading by Chain Procedure, Class Number, and Code Number.

The technique of facet analysis, invented in India, permeates many of the other papers. The volume ends with a 30-page summary of the discussions on the papers. The discussions focus on the seeking for the standard qualities to be usefully possessed by any classificatory or machine language.

The Conference was partly a result on the Congressional Sub-Committee on Reorganisation (of the Committee on Government Operations). The Conference led to the formation of an International Continuation Committee. India has been assigned a place on it.

S. R. RANGANATHAN.

Cotton in India—A Monograph, Vol. III. By C. Nanjundayya, R. L. N. Iyengar, W. R. Natu, M. B. Ghatge, K. S. Murti, C. B. Parikh, B. L. Sethi and D. N. Mahta. (Indian Central Cotton Committee, 14, Nicol Road, P.B. No. 1002, Bombay-1), 1960. Pp. vii + 295. Price Rs. 30.

The present volume has six chapters dealing respectively with Technology, Ginning and Pressing, Marketing, Consumption of Cottonseed, Consumption of Cotton lint, Legislative

measures and Exports and Imports. Each of the chapters has been handled by persons who with their long experience can speak with authority on their respective subjects.

The chapter on Technology gives a good account of the development and characteristics of the cotton fibre and methods of estimating quality of the fibre from the yarn spun from it. Nearly twenty pages of this chapter deal with the application of statistics which should certainly be considered out of place in this monograph as statistical principles are the same in whatever field of investigation they may be applied to.

The account on ginning and pressing describes, starting from the primitive methods the development of the various types of machinery now in use. The cotton ginning industry is almost parallel to rice milling industry of the country capable of considerable improvement and indications are given of the scope for such improvements. We wish the terms 'cotton' and 'lint' are more discriminately used in this chapter.

The chapter on consumption of cotton-seed brings together all available information on the structure of the seed, the extraction of different parts, their composition and uses. The different methods of oil extraction from the seed, the uses to which the cake and the oil are put to and the general position of the cotton seed oil industry in the country are described.

The various legislative measures that have had to be enacted to prevent malpractices in trade and to maintain purity of improved varieties grown in particular areas are discussed in the last chapter which also includes measures taken to prevent spread of particular insect pests. Due however, to the laxity in the enforcement of the Acts, the malpractices of trade have not been fully eliminated though they have been somewhat minimized.

The volume closes with a short account on 'Exports and Imports of Cotton'. The book contains valuable information and could be recommended as a useful reference to all interested in the various aspects of cotton industry in the country.

K. R.

Proceedings of the Centenary and Bicentenary Congress of Biology, Singapore, 1958. Edited by R. D. Purchon. (University of Malaya Press, Singapore), 1960. Price $ 13.50 net.

The University of Malaya commemorated in 1958 the works of Darwin, Wallace and Linnaeus and brief reviews of the proceedings of the Congress have already appeared in several journals. The papers presented at the Congress have now been brought out as a volume. It is a fitting memorial to Wallace who arrived at conclusions essentially similar to those of Darwin on Evolution while working in Malaya. The papers are interesting because they deal with tropical life which present problems more complex than those of temperate and arctic regions.

M. K. SUBRAMANIAM.

CORRECTION

The Price of the book "Mandl: *Introduction to Quantum Field Theory*," reviewed on p. 76 (February 1961) should *read* as 6.00 U.S. Dollars and *Not* 16.00 Dollars.

Books Received

Organic Electronic Spectral Data (Vol. I, 1946-52), (Vol. II, 1953-55). Edited by M. J. Kamlet and Herbert E. Ungnade. (Interscience Publishers, New York). Pp. xiv + 1208, Pp. x + 919. Price $ 28.50, $ 17.50.

Russia's Rocket and Missiles. By A. Parry. (Macmillan & Co., Ltd., St. Martin's Street, London, W.C. 2), 1960. Pp. 382. Price 25 *sh.*

Indian Woods, Vol. I. By K. A. Chowdhury and S. S. Ghosh. (Manager of Publications, New Delhi), 1958. Pp. liii + 304. Price Rs. 25·50.

Fatty Acids—Their Chemistry, Properties, Production and Uses, Part I. Edited by K. S. Markley. (Interscience Publishers, New York), 1960. Pp. ix + 714. Price $ 22.50.

Elements of the Theory of Markov Processes and their Applications. By A. T. Bharucha-reid. (McGraw Hill Book Co., New York), 1960. Pp. xi + 468. Price $ 11.50.

Preparative Methods of Polymer Chemistry. By W. Sorenson and Tod W. Campbell. (Interscience Publishers, New York), 1961. Pp. viii + 337. Price $ 10.50.

Introduction to the Statistical Dynamics of Automatic Control Systems. By V. V. Solodovnikov. (Dover Publications, New York-14), 1960. Pp. xx + 307. Price $ 2.25.

Biochemical Society Symposium No. 20—The Biochemistry of Mucopolysaccharides of Connective Tissue. (Cambridge University Press, London, N.W. 1), 1961. Pp. 125. Price 15 *sh.*

British Medical Bulletin (Vol. 17, No. 1, January 1961)—*Hypothermia and the Effects of Cold.* (The Medical Department, The British Council, 65, Davies Street, London, W. 1). Pp. 78. Price 20 *sh.*

SCIENCE NOTES AND NEWS

Polyembryony in Mulberry

Shri B. C. Das, Central Sericultural Research Station, Berhampore, West Bengal, writes :

The phenomenon of polyembryony, although common in gymnosperms, is only sporadic in the angiosperms. In the present case the author came across a case of polyembryony in mulberry in course of a germination experiment. Seeds were obtained from a cross between an indigeneous mulberry—*Morus indica* Linn. var. *laciniata* (kajli) and a Chinese mulberry—*M. alba* Linn. In order to study the percentage of germination of F_1 seeds, they were allowed to germinate in a petri dish in March, 1961, when one twin seedling with two plumules and two radicles was noted to emerge from a single seed (Fig. 1).

FIG. 1. A polyembryonous mulberry seedling with two plumules and two radicles.

This specimen has been preserved in the laboratory.

Effect of Gibberellic Acid on Berseem

Messrs. J. S. Kanwar and S. L. Chopra of the Government Agricultural College, Ludhiana, write :

Pot experiments conducted during the years 1959-60 have shown that the yield of berseem (*Trifolium alexandrinum*) can be nearly trebled by spray treatment with gibberellic acid (GA). The berseem plants were grown in pots each pot containing 20 lb. of Ludhiana fine sandy loam soil. To each pot was added 2·5 gm. of superphosphate, which is equivalent to 100 lb. of P_2O_5, per acre. GA solution was sprayed on the plants before first cutting only. There were six treatments in all the first five with 0·25, 0·50, 0·75, 1·00 and 1·50 mg. of GA per pot, and the sixth one with 1·50 mg. GA *plus* 1 mg. urea. There were four replicates of each treatment, and three cuttings of green fodder were taken to analyse the effect of treatment on yield.

The total yields of dry matter in the six treatments were respectively 28·0, 31·4, 101·5, 98·0, 110·5 and 75·0 gm. per pot, as against 40·8 gm. per pot of the control. The maximum yield of 110·5 gm. (control 40·8 gm.) was obtained with 1·50 mg. of GA. The yield on the first cutting alone showed a nearly five-fold increase with this concentration, namely 1·50 mg. of GA. These preliminary experiments clearly bring out the potentialities of the use of GA in increasing the yield of this useful fodder crop.

Control of Safeda Muskmelon Fruit Rot

Messrs. R. S. Mathur and S. C. Verma, Laboratory of Plant Pathology, U.P., Kanpur, write :

Near about Lucknow severe fruit rotting of Safeda muskmelons (*Cucumis melo*) is caused by a wound parasite *Pythium aphanidermatum* (Eds.) Fitz., the predisposing factors being skin injury to fruits and their contact with wet soil. In replicated field trials conducted at Kanpur and at Lucknow during 1958-60, the current practice of sowing by broadcast of seed and heavily irrigating the muskmelon beds where the fruits come in contact with wet soil, was changed and, further, the skin injury to the fruits was prevented by dusting the fruit-bearing vines weekly with Pyrodust. When sowing was done by dibbling and the roots were so irrigated with water in channels that the adjacent plots were kept dry for the fruit-bearing vines to spread, fruit rotting was negligible as compared to an average of 25% fruit rotting in the check plots.

The British Association for the Advancement of Science

The 123rd Annual Meeting of the British Association for the Advancement of Science will be held this year at Norwich, England, from August 30 to September 6. The BAAS was founded in 1831 to promote general interest in science and its applications. One of its chief activities is the Annual Meeting, which is attended by eminent scientists as well as young students. It has 14 sections covering the whole range of pure and applied science.

This year's meeting will be under the presidency of Sir Wilfrid Le Gros Clark, Professor of Anatomy at Oxford University. Sir Wilfrid has worked on the regeneration of the central nervous system, with experimental studies on the growth and regeneration of the muscular system. At the same time, his wide knowledge of fossils has been extensively recognized.

A wide variety of topics of fundamental and current interest will be discussed at the meeting, and will include detection of underground nuclear explosions, new particles, new sources of power, the living cell, and food processing and health. The Eidophor process, which makes possible large-screen projection of colour television, will be demonstrated. In addition, this system will be used to transmit the inaugural meeting in full colour to an overflow audience.

Institution of Chemists (India)—*Associateship Examination*, 1962

The Twelfth Associateship Examination of the Institution of Chemists (India) will be held in November, 1962. The last date for registration is 30th November 1961. The Examination in Group A (Analytical Chemistry) is divided into the following eleven Sections and each candidate will be examined in two of them according to his choice as approved by the Council, in addition to the General Chemistry including Organic, Inorganic, Physical and Applied Analytical Chemistry: (1) Analysis of Minerals, Silicates, Ores and Alloys; (2) Analysis of Drugs and Pharmaceuticals; (3) Analysis of Foods; (4) Analysis of Water and Sewage; (5) Biochemical Analysis; (6) Analysis of Oils, Fats and Soaps; (7) Fuel and Gas Analysis; (8) Analysis of Soils and Fertilisers; (9) Analysis connected with Forensic Chemistry; (10) Analysis connected with Leather Chemistry, and (11) Analysis connected with Textile Chemistry. The Examination is recognised by the Government of India as equivalent to M.Sc., in Chemistry for purposes of recruitment of Chemist.

Further enquiries may be made to the Honorary Secretaries, Institution of Chemists (India), Chemical Department, Medical College, Calcutta-12.

Symposium on Low-Temperature Carbonisation of Non-Caking Coals

A symposium on 'Low-Temperature carbonisation of non-caking coals and briquetting of coal fines' is being organised at the Regional Research Laboratory (Council of Scientific and Industrial Research), Hyderabad-9, on November 20, 21 and 22, 1961.

Those who wish to participate in the symposium are requested to send before August 15, a brief abstract of the paper to be presented at the meeting. This should be followed by the detailed paper by September 15, 1961. Pre-prints of research and technical papers will be supplied to the participants by October 15, 1961.

All communications and enquiries in connection with the symposium may be addressed to the Director, Regional Research Laboratory, Hyderabad-9 (A.P.).

Journal of Theoretical Biology

Academic Press, London and New York Publishers, have just released the first issue of the *Journal of Theoretical Biology* of which Professor J. F. Danielli, King's College, London, is Chief Editor. This new international periodical will serve as a central medium for the publication of original papers in theoretical biology. The following contributions in Volume 1, Number 1, Pp. 1-106, January 1961, will indicate the scope of the journal and its utility to persons concerned. Possible functions of chains of catalysts, by R. J. P. Williams; Permeation through a spherical membrane, by G. G. Hall; Quanta and the concept of organismic law, by Walter M. Elsasser; Methods for measuring and correcting the absorption spectrum of scattering suspensions, by J. Amesz, L. N. M. Duysens, and D. C. Brandt; The supra- and submolecular in Biology, by Albert Szent-Gyorgyi; An analysis of the idea of "Resources" in animal ecology, by H. G. Andrewartha and T. O. Browning; Reductions and oxidations in mammalian biosyntheses, by John M. Lowenstein; Surface extension as the mechanism of cellular movement and cell division, by L. G. E. Bell.

The rate for institutional subscribers to Volume 1 is 121 s. 6 d. or $ 17.00. Scientists certifying issues will be for their personal use

only are offered a special subscription price of 86 *s.*, or $ 12.00 for Volume 1.

Indian Journal of Microbiology

The Association of Microbiologists of India, founded in 1938, have undertaken the publication of a new journal *'Indian Journal of Microbiology* which will be a quarterly coming out on the last day of March, June, September and December. The object of the Journal is to publish the results of microbiological research in India in all the divergent and specialised directions it is taking.

The contents (noted below) of the first issue of the journal (Vol. 1, No. 1, Pp. 1-64) will indicate the general scope of the Journal although they are by no means an index of the large amount of work that is being carried out in this field of study in the country. Amide Hydrolysis by *S. typhosa* ; Nucleolytic Enzymes of *S. typhosa* ; Rhizosphere Bacteria of Wheat and Berseem ; *Escherichia coli* Serotypes ; Influence of Soil Solution on Nitrogen Fixation ; Antivitamins and Excretion of Amino-acids by *V. cholerœ* ; Turnip Crinkle Virus in India ; Potassium Nutrition and Multiplication of Tobacco Mosaic Virus ; Heat Resistance of *B. subtilis* Spores ; Concentration Methods for Tubercle Bacilli ; *Candida* infection in Leucorrhoea.

The annual subscription of the Journal for non-members is Rs. 15 (Inland) and Rs. 20 (Overseas), Address : P-27, Prinsep Street, Calcutta-13.

Biological Effects of Radiation

New research findings on the biological effects of atomic radiation were reported at a study group meeting organized by the International Atomic Energy Agency in Vienna last month.

One of the subjects discussed was the mechanism by which radiation damages the cell. This may well be described as the fundamental problem in radiobiological research. While in the past the radiation damage itself has been studied in great detail, the exact process by which it is caused is still not clear. One of the theories discussed at length at the Vienna meeting was that radiation leads to the release of enzymes within the cell and this in turn may cause destructive chemical changes in the cell structure. Another theory discussed at the meeting dealt with modification of the permeability of cell membanes, which might be connected with the enzyme release hypothesis.

The meeting also discussed how the findings of radiobiological research could be used in devising new methods of food preservation. It was disclosed that experiments on the sterilization of food by the combined use of heat and low-level radiation appeared particularly promising ; this would obviate the necessity of using very large radiation doses that might have undesirable effects on the food.

In the field of drugs, there was a discussion on preliminary results of experiments to produce polio vaccine by using a combination of radiation and chemical agents for the inactivation of the virus. The possibility of using radiation for virus research was also mentioned ; a new technique suggested at the meeting is to irradiate the cells of experimental animals in order to make them accept human viruses so that the growth, behaviour and control of the viruses can be effectively studied.—(*I.A.E.A. News.*)

Polyvinyl Chloride Coating Makes Glass Bottles Safer

A process which aims at lessening the effect of possible explosions of glass bottles containing volatile liquids has been suggested by Rene Droessaert of France. The process consists in coating the outside of the bottles with a layer of polyvinyl chloride (PVC). As PVC cannot be applied direct to the glass, the bottle is dipped in a solution of vinyl chloride and vinyl acetate, dried in air for a minute and then baked at a temperature of 180° C. for three minutes. The final layer of PVC is applied and baked for thirty minutes at 155° C. If this temperature is raised to 325° C. the PVC becomes transparent.—(*New Scientist.*)

The Ecology of Acantharious (Radiolaria) in Relation to the Circulation of Sr in the Sea

It has been known for a long time that a class of Radiolaria, the Acantharious, possess a mineral skeleton which is not calcareous or silicous, but is formed by celestite ($SrSO_4$).

A way of investigating the nature of the sticules was to investigate the isolated material by X-ray crystallography. Such a technique was used by Professor L. Cavalca (University of Parma). The results have shown that the sticule is a rhombic monocrystal of $SrSO_4$. Chemical analysis on 500 individuals have further yielded a value of Sr of 0·1–0·3 for every individual.

The fact that the presence of Acantharious in the plankton varies with the season and their rapid and considerable vertical migration, suggest that these zooplankton components are very useful for studying the problem of a monitoring technique of Sr 90.

The aim of the research, which will be carried out at the Department of Zoology, University of Parma, is to ascertain the role of the Acantharious in the capture and the distribution of Sr in the food chain both of natural isotopes present in the sea and of the radioactive Sr present in fall-out.—(*IAEA-Research Contract.*)

Removing Sulphur Fumes from Chemical Plants

Hydrogen sulphide, found in the waste gases emitted from chemical plants, may be oxidized and converted into sulphur, using what has been claimed by the Osaka Gas Company in Japan, to be a new, simple and economic process.

The gas, mixed with air at room temperature, is brought into intimate contact with an organic catalytic solution, and the sulphur so formed is removed either by filtration or by skimming off the sludge that floats on the surface of the liquid. The catalyst can be almost any nitrated phenol; the example quoted by the Company is picric acid.

The process could have considerable advantages if it were linked with one of the well-known processes for extracting hydrogen sulphide from coal or producer gas and subsequently discharging it into the atmosphere.—(*New Scientist.*)

Electrons in the Primary Cosmic Radiation

Although the question of the presence of electrons in the primary cosmic radiation has frequently been discussed in literature attempts to identify such a component have so far been negative. P. Meyer and R. Vogt of the Enrico Fermi Institute for Nuclear Studies have reported (*Phys. Rev. Letters*, 1961, **6**, 193) an experiment which leads to the conclusion that there exists a flux of electrons which enters the top of the atmosphere.

Three balloon flights for cosmic ray investigation at high altitudes were carried out in August-September 1960, from Fort Churchill Manitoba, which has a calculated geomagnetic cut-off rigidity for vertically incident particles of about 100 Mv. Data were obtained in each flight during the ascent and for approximately 10 hours under 3 to 5 g./cm.^{2} of residual atmosphere.

Cosmic ray "events" were recorded by the conventional detector system consisting of NaI end counters with lead absorbers and intermediate range counters. Analyses of the range spectrum of the "events" have revealed that all of them could not have been produced by high energy protons and mesons only, but that a substantial fraction of the "events" was to be attributed to primary electrons. Further, results of analysis have also shown that primary electrons above the calculated geomagnetic cut off of 100 Mv. were present in the incoming radiation, and these could only be of interplanetary or of galactic origin. It should also be noted that the flights were conducted at a time of normal solar activity.

Intensity Sensitivity of the Human Eye

At the Fifth Annual Conference of the British Society for the Philosophy of Science, held in Bristol in September 1960, Dr. M. H. Pirenne (Oxford) presented the results of his experiments on the threshold intensity of light visible to the human eye. According to these experiments there was not a sharp transition from visibility to invisibility as the energy of a light-flash was decreased, and threshold was defined by an arbitrary statistical measure in the range of critical intensities. The results showed that the human eye could detect flashes of about 100 quanta in the narrow band of blue-green wavelengths to which the periphery of the retina was most sensitive. Of these 100 quanta in the light-flash only about 10 reached the retina and were there distributed among about 500 rods.—(*Nature*, 1960, **188**, 458.)

Mesta as a Border Crop on Sugarcane Plantation

It has been established by intensive field research that a crop of mesta (*Hibiscus cannabinus*) grown on the periphery and along the water channels of sugarcane field, can yield 4 to 5 mds. of fibre per acre.

The cultivation of mesta, which yields a fibre comparable to jute in many respects is a long established practice in India.

The cost of mesta production is generally low because it is hardy crop and it will be still lower if cultivated as a border crop on a sugarcane plantation. Upwards of 4 million acres are planted annually with sugarcane in India. The growing of mesta along with sugarcane on even a fraction of this vast area can lead to a large increase in the supply of fibre.—(*Indian Central Jute Committee, Calcutta*-1.)

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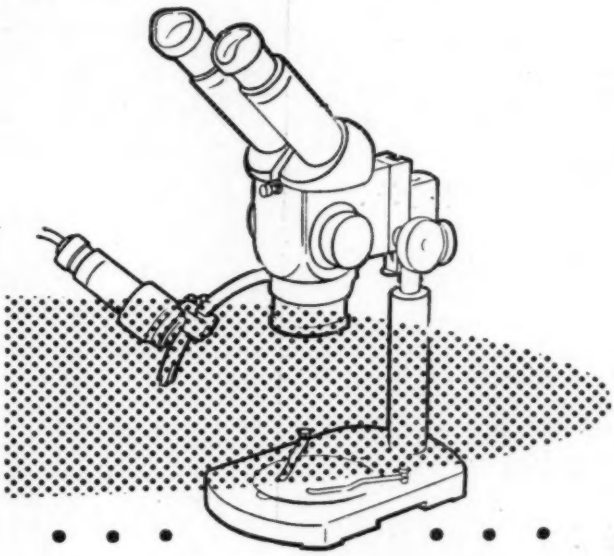

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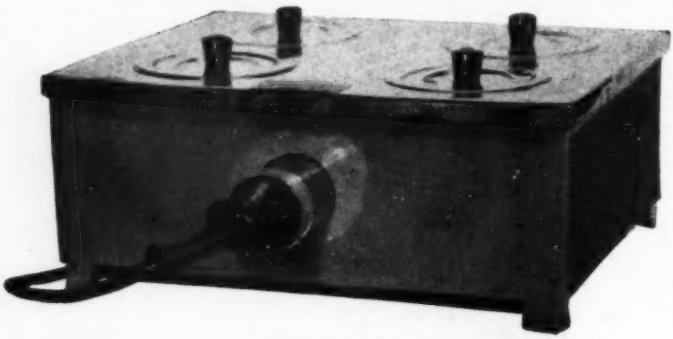

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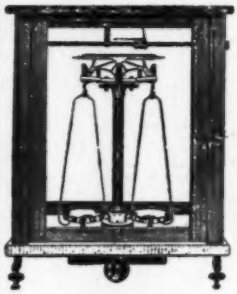

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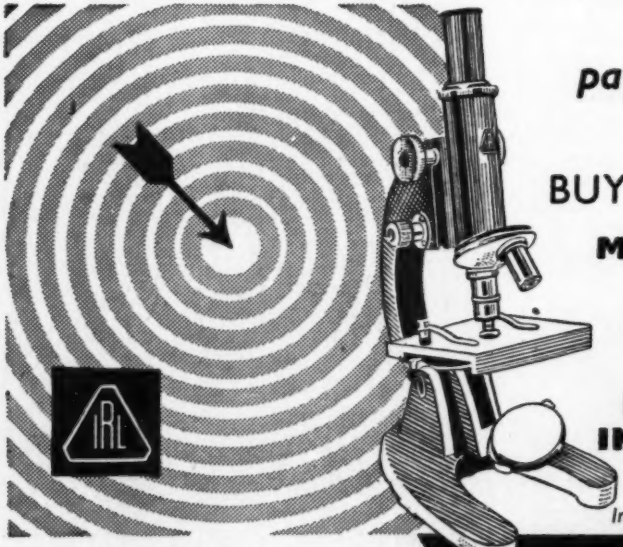

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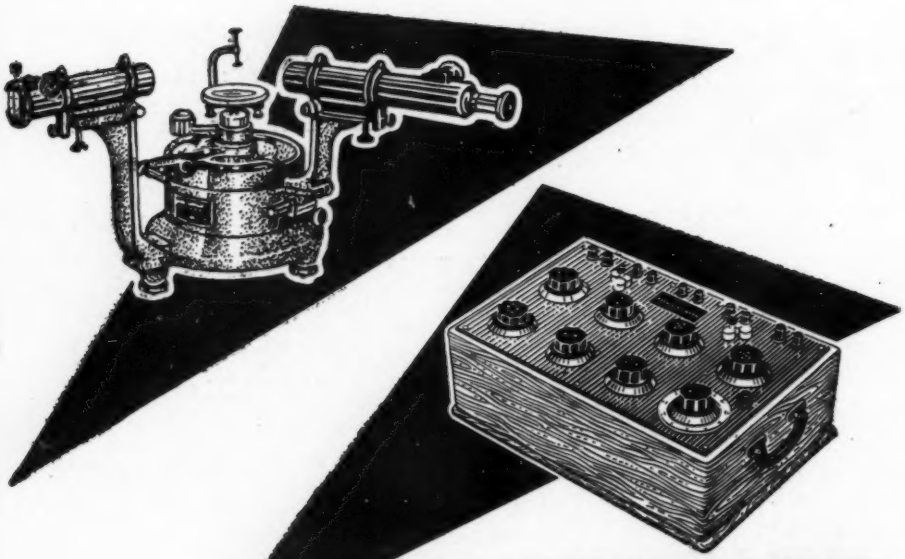

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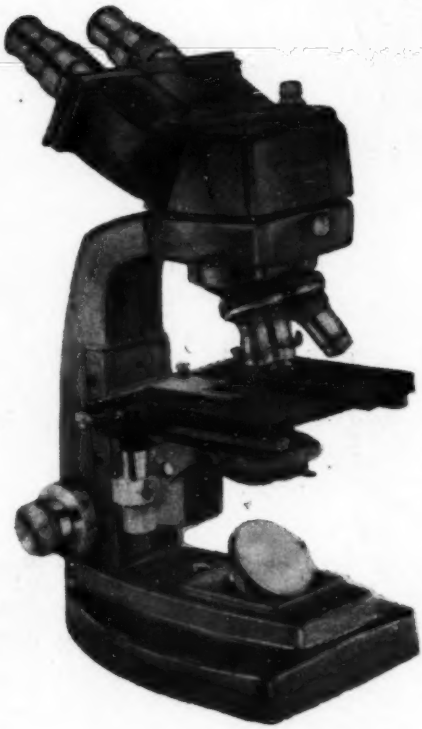

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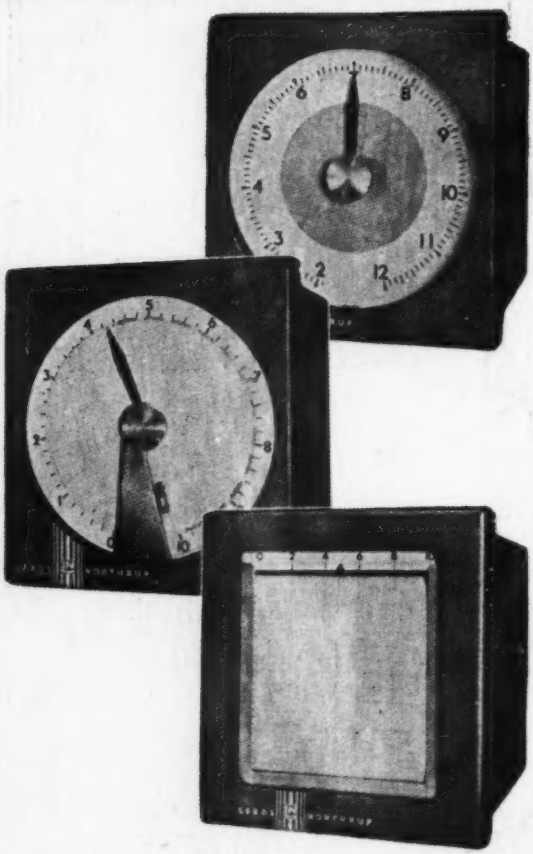

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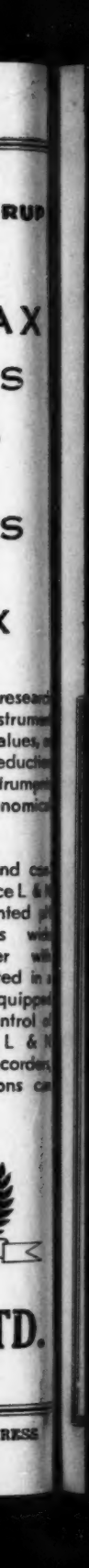
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